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Norwegian climatology, the Republic of Letters and the Nordic Enlightenment

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ABSTRACT

Although natural philosophers of Enlightenment Europe shared common ideals, like reliance on reason and natural philosophy, to promote what they deemed to be progress; there were national differences in attitude and disciplinary focus. This paper takes various eligibility criteria as a starting point from which to define a Nordic Enlightenment science; and situates endeavours in climate science within visions of useful science and international conventions for scientific practice. Two perspectives are explored: the make-up of the Nordic Enlightenment science; and the Nordic natural philosopher's various platforms for work and knowledge transfer. While historians differ as to what constitutes Enlightenment thought and spirit, I establish the existence of a Nordic Enlightenment science by identifying and examining several of its indicators. The paper concludes with a more specific discussion of climate science in Norway in which I show how climate observations performed during the eighteenth century by a sample of Norway's clergymen and civil servants bear testimony to an internationally-oriented science, through articles produced for science journals and conventions followed for data presentation and instrumentation. The findings corroborate existing knowledge of a progress-driven, Enlightenment science in Nordic countries; reveal differences between countries, and present Norway's early-modern climate science in an international light.

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1. Introduction

Until quite recently, some historians seem undecided as to whether a Nordic Enlightenment ever took place and, if it did take place, what it comprised.[1]

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[1]Ruth Hemstad in "'Norden' og 'Skandinavien' Begrepsbruk i brytningstid', *Nordens historiker: En vänbok till Harald Gustafsson*, eds. Erik Bodensten and others (Lund: Historiska Institutionen, 2018), p. 28, 45–61 (p. 47). Hemstad writes on p. 47 of multiple references to 'Scandinavia, our Fatherland'('*Scandinavien, vort Fædreland*') and to the

This article has been corrected with minor changes. These changes do not impact the academic content of the article.

The notion of a Nordic Enlightenment is further clouded by the different labels assigned to it. Eighteenth century science in Nordic countries is sometimes referred to as Baltic Enlightened,[2] Germano-Scandinavian,[3] a 'Scandinavian Enlightenment' or 'Northern Enlightenment'.[4] I first review some of the main points of discord in the more general Enlightenment debate, as they help me map the intellectual pursuits that can be branded as 'Enlightenment science'. Secondly, I present examples of Enlightenment scientific activity, both regionally (in this context, the Nordic region)-, nationally and/or transnationally.

The Enlightenment was a period spanning the second half of the seventeenth century to the ending of the Napoleonic Wars in 1815. A modernization thesis might say it was an intellectual movement led by liberal thinkers who translated philosophy into policy and advocated useful science to better the welfare of people. Such a thesis is branded by some as a 'textbook version of history' in which political philosophy from the Enlightenment is linked to the emergence of a modern, western liberal democracy.[5] Peter Gay (1967), associated with the modernization thesis, has been criticized for relying too heavily on the philosophical activity from a 'narrow circle of *philosophes*'.[6]

There is also the question of the extent to which historians can reasonably describe the Enlightenment as rational or mystical, national or transnational, secular or religiously orthodox. de Dijn (2012) finds support for the notion that France's philosophers campaigned for a more rational, less superstitious, society. She writes:

> They believed that they and their brethren were united in a campaign to modernize the world – that is, to make it less superstitious, more rational, in a word, more enlightened. But they did not think they were trying to overthrow the Old Regime. When the philosophes talked about the need to écraser l'infâme, they meant the church, not royal absolutism. They defined their age as one of reason, not freedom.[7]

geo-political significance of a Nordic organization in a world with increasing, Russian and German influence. See also the reference to King Frederik 6 who in 1810 promoted his candidacy to rule a united Scandinavia, comprising Denmark-Norway and Sweden, in Hemstad's article 'Geopolitikk og geografibøker for folket', in *Sann opplysning? Naturvitenskap i nordiske offentligheter gjennom fire århundrer*, eds. Merethe Roos and Johan Tønnesson (Oslo: Cappelen Damm akademisk, 2017), pp. 100–26 (p. 106). See L. Grane in Københavns Universitet 1479-1979 (Copenhagen: Det teologiske fakultet, 1980), who on p. 248 refers to the years 1750–1788 as 'Denmark's Enlightenment' and 1788–1830 as its period of rationalism. Translations from Norwegian, Swedish and Danish are mine, unless otherwise specified.

[2]Lisbet Koerner, *Linnaeus: nature and nation* (Cambridge, MA and London: Harvard University Press, 2000), p. 35. Koerner writes the Swedish towns of Lund and Uppsala, where Linnaeus studied, are '… Baltic university towns …' (p. 35) and refers to Sweden's Carl Linnaeus as '… this old-fashioned Baltic professor' (p. 25). Also in *The Sciences in Enlightened Europe*, eds. William Clark, Jan Golinski, and Simon Schaffer (Chicago, IL: University of Chicago Press, 1999) Koerner assigns a Baltic identity to Linnaeus.

[3]William Clark and others, *The Sciences in Enlightened Europe* (London: University of Chicago Press, 1999).

[4]Håkon W. Andersen and others, *Aemula Lauri: The Royal Norwegian Society of Sciences and Letters, 1760–2010* (Sagamore Beach, MA: Science History Publications, 2009).

[5]Annelien de Dijn, 'The Politics of Enlightenment: from Peter Gay to Jonathan Israel', *The Historical Journal*, 55 (2012), 785–805 (p. 785).

[6]Jan Golinski, 'Science in the Enlightenment, Revisited', *History of Science*, 49 (2011), 217–31, 234 (p. 219).

[7]de Dijn, p. 786.

If indeed these international types, Voltaire (1694–1778), Charles-Louis Montesquieu (1689–1755) and Jean-Jacques Rousseau (1712–1778), of whom de Dijn writes, had it out for the Church; then it comes as no surprise that other scholars picture an Enlightenment in which people moved away from religious conundrums and towards secular ones.[8] Yet, the idea that a rational study of the physical, material world lay at the heart of Enlightenment philosophy, at the expense of spirituality; has not gone uncontested.

Within an Enlightenment historiography that increasingly allows for philosophers who lived and worked in a plurality of worlds; Jansson and Falk (2017) position progressive ideas on civil rights in an Enlightenment frame. Followers of philosopher and Christian mystic Emanuel Swedenborg (1688–1772) were critical of Europe's slave trade.[9] The work *Plan for a Free Community upon the Coast of Africa …* (1789) was penned by three Swedenborgians. 'Swedenborgians' is a reference to men who subscribed to the theology of Swedenborg and who formed Swedenborgian societies in the 1780s.[10] In *Plan*, the authors advocate a 'Free Community' in Africa:

> As is the design of this Plan, that our Free Community shall be erected in Africa, consequently among the Negro Nations, not for any of the baser purposes of usurping Dominion over them, disturbing their Peace, enslaving their Persons, or debauching their Manners; but for the nobler purposes of civilising, and gradually incorporating them into our Community, by every gentle means, as by regular Marriages, the education of their Children, &c. so it will become the indispensable duty of every Member to Spare no pains for promoting this beneficial purpose. Therefore, instead of Slavery, a gentle Servitude is to be instantly adopted, and every Native redeemed from Slavery shall be free after a Service or Apprenticeship of a few Years.[11]

The excerpt above advocates a form of colonialism on the one hand, and on the other, an ideal of man as his own master.[12] If the championing of universal human rights can be viewed as enlightened, the activism of *Plan* signatory

[8]Margaret C. Jacob, *The Radical Enlightenment: Pantheists, Freemasons and Republicans*, 2nd edn rev. (Lafayette: Cornerstone Book Publishers, 2006).

[9]Anton Jansson and Hjalmar Falk, 'Religion i det svenska idéhistorieämnet – Översikt och reflektion', *Lychnos: Lärdomshistoriska samfundets årsbok* (2017), 75–95, Jansson and Falk write on p. 88. ' … it is obvious that Swedenborg's and his disciples' slavery resistance represented a more radical position from a human rights´ point of view than that taken by their Voltaire-reading opponents, such as Kellgren.'

[10]Britannica, The Editors of Encyclopaedia, 'Emanuel Swedenborg' in *Encyclopedia Britannica* < https://www.britannica.com/biography/Emanuel-Swedenborg> [accessed 10 April 2023].

[11]*Plan for a Free Community upon the Coast of Africa* (London: printed by R. Hindmarsh, Printer to his Royal Highness the Prince of Wales, No. 32, Clerkenwell-Close, 1789), 65. Page 51 reveals the signatories' names; August Nordenskjold and Charles Bernhard Wadstrom from Sweden; Colborn Barrell, America; Johan Gottfried Simpson, Prussia.

[12]A separate, Enlightenment ideal of man's mastery over nature, has its own critics. See Dorinda Outram's discussion of Max Horkheimer and Theodor Adorno's (1944) *Dialektik der Aufklärung*. The work claims that apart from its secularism, the Enlightenment stands for icon-smashing on the one hand, and metaphysics of scientific reason, on the other. Through its near-worship of science and utility, the Enlightenment carried within it a form of thought and attitudes that were the necessary forerunners of the Holocaust. In William Clark, Jan Golinski, and Simon Schaffer, *The Sciences in Enlightened Europe* (Chicago, IL: University of Chicago Press, 1999), pp. 10, 33.

Carl Wadström (1746–1799) is indicative of a Nordic Enlightenment. Wadström stood before the British Privy Council in 1788 as a witness to the cruelties of the slave trade. Moreover, he commended Africans based on their 'extraordinary genius of commerce' and promoted the idea that they could be 'brought into such a state of society as we enjoy in Europe'.[13]

Lastly, one may ask whether Enlightenment philosophers were first and foremost international types or mere patriots representing their home realm, or region. Roy Porter's (2000) British Enlightenment, for example, has been dismissed by one scholar as '… an inclusive, unconflicted, cheerfully Protestant affair, which many historians would find questionable.'[14] Others, like Evju (2019), are quite content to acknowledge national Enlightenments, alongside regional and transnational ones. He discusses a Nordic Enlightenment in which public debate flourished, especially around topics of political economy.[15] In the political discourse across Europe on agrarian reform, especially as related to ideas of an ancient constitutionalism, Evju nonetheless notes national idiosyncrasies. Philosophers of the Scottish Enlightenment, among these David Hume (1711–1776), dismissed romantic references to the ancient constitutions of England and Scotland, since liberty was something decidedly modern that was connected to the rise of a commercial society. Philosophers in France called out rhetoric that praised the glory days of popular liberty, as reactionary, but there were notable exceptions.[16] In a Dano-Norwegian context, the discourse about a Northern antiquity in which the peasantry was free and protected by law, was anything but reactionary. Far from being relics of the privileges enjoyed by warring feudal barons or a 'mere defence of the existing form of government';[17] appeals to a past in which king and peasant stood shoulder to shoulder, were well-timed arguments in the struggle for agricultural reforms in Denmark-Norway. Evju's nuanced argument serves as a reminder that an Enlightenment ideal of progress need not be synonymous with a modernity ideal divorced from the past. Agrarian reform in the Dano-Norwegian context was pursued through appeals to the past, to tradition. For example, in the uniquely Norwegian, and highly controversial, debate about a freeholder's traditional, familial right to redeem landed property (*odelsretten*); backward-looking rhetoric struck a blow for equal distribution of property, and for the protection of farmers and their family from 'scheming merchants

[13]Jonas Ahlskog, 'The Political Economy of Colonisation: Carl Bernhard Wadström's Case for Abolition and Civilisation', *Sjuttonhundratal*, 7 (2010), 146–67 (p. 149). Ahlskog writes that Wadström voiced views on civil liberties multiple times, while in London (1788–1795).
[14]Karen O'Brien, 'The Return of the Enlightenment', *The American Historical Review*, 115 (2010), 1426–35 (p. 1434).
[15]Håkon Evju, *Ancient Constitutions and Modern Monarchy* (Boston, MA: BRILL, 2019).
[16]Evju, pp. 11–12. See also Annelien de Dijn, *French political thought from Montesquieu to Tocqueville: liberty in a levelled society?* 89. (Cambridge: Cambridge University Press, 2008). Of French historian and nobleman Henri de Boulainvilliers (1658–1722), she writes 'In the *Histoire* as in the *Lettres*, Boulainvilliers made his case against the growth of royal absolutism by invoking the French past … In particular, his defence of feudal rights and the right of ownership of the Franks over the Gauls went against the egalitarian sensibilities of French republicans. In the end, it was Boulainvilliers' goal to argue that liberty was impossible without an aristocracy' (pp. 16, 20).
[17]Evju, p. 13.

and sawmill owners' who sought to acquire landed property for a quick profit.[18]

My working definition of the Enlightenment entertains national-, regional and transnational identities. It includes Gay's (1967) elements of secularism, humanity, cosmopolitanism and freedom,[19] and adds to these, religious orthodoxy, ruralism and cameralism. More specifically, my study focuses on science and philosophers in Nordic countries. My treatment of Nordic Enlightenment science deals mostly with Sweden and Norway (but also Denmark and Iceland, to some extent) and I demonstrate multiple channels through which Nordic Enlightenment science manifested itself; societies of science and clubs, an international Republic of Letters and other literary platforms, the state Church, and the civil service. Lastly, I entertain the example of early-modern climate science in Norway and show through the work of four climate scientists how they were integrated into an international, scientific community and actively contributed climate knowledge to that same community. In short, my purpose is to argue for the existence of a Nordic Enlightenment science, at a general level; and to demonstrate, at a specific level, how one Nordic nation's natural philosophers played a role in early-modern, climate science.

Interestingly, some scholars have raised doubts about an Enlightenment period ever existing in the Nordic region. Jakobsen (2015) expresses such a sentiment in the case of Norway, here with a reference to Bishop Johan Ernst Gunnerus (1718–1773), the man perhaps most associated with Enlightenment science in Norway.[20]

> … it is often called the Enlightenment period. Much of what engaged Gunnerus, resembles central, Enlightenment ideas. This includes the priority assigned to rational thought in general as well as the empirical work involved in recording natural phenomena. I have nonetheless restrained from denoting this epoque as 'the Enlightenment era' and shown equal hesitancy in using the term 'Enlightenment' as a key term to make sense of Gunnerus' scientific work.[21]

Other scholars position Nordic philosophers in a 'Baltic Enlightenment', a catch-all phrase based on scattered geographical, historical and political criteria:

> By 'Baltic' I mean all countries facing the Baltic Sea. This includes Denmark and Sweden. It incorporates Finland, which was part of Sweden until 1809, when it was ceded to Russia (it became independent in 1919). It also includes Russia, because after defeating Sweden in 1709, and capturing Ingria, Russia occupied the eastern

[18]Evju, p. 208.
[19]Peter Gay, *The Enlightenment: An Interpretation: The Rise of Modern Paganism*, 2 vols (London: Weidenfeld and Nicolson, 1967), I, pp. 3, 33.
[20]Brita Brenna, 'Clergymen Abiding in the Fields: The Making of the Naturalist Observer in Eighteenth-Century Norwegian Natural History', *Science in Context*, 24 (2011), 143–66 (p. 145). 'Early modern natural philosophy and natural history in Norway have not been extensively researched, and Gunnerus is in fact the one who has received most attention.'
[21]Rolv Nøtvik Jakobsen, *Gunnerus og Nordisk Vitskapshistorie* (Oslo: Scandinavian Academic Press, 2015), pp. 12, 13.

> Baltic littoral … 'Baltic' here also means Denmark's Atlantic dependencies: Norway (ceded to Sweden in 1814, and independent in 1905); Iceland (independent in 1943); and Greenland (partially independent in 1979). It also encompasses Poland …[22]

It is not evident that any of the Nordic natural philosophers mentioned in this article thought of themselves as Baltic or regarded Swedish universities as, to quote Koerner (2000), 'North Baltic universities'.[23] Correspondence between Carl Linnaeus (1707-1778) and contemporaries reveals a perceived identity based on nationality and even region (Nordic); but not on physical orientation to the Baltic Sea.

However, non-Nordic contemporaries could describe their Nordic peers as being 'Northern', as evident in a letter of circa January 1761 from the Scottish-born physician and naturalist Alexander Garden (1730–1791) to the Irish naturalist, John Ellis (1710–1776). In the letter, Garden wrote of a box of snakes and well-preserved fish he had shipped to Ellis (presumably in London) so that Ellis may re-ship these to Linnaeus. Garden left instructions for Ellis:

> I have made out characters of most of the fish I have sent, merely that Linnaeus might correct me; but I am grieved that I cannot hear oftener from him … The fish are in the long box which has the brown paper about it, and the snakes in the square box. I must beg you will take particular care of these, as I hope, if they arrive safe, they will convince our great Northern father and leader, that I have taken as much pains as I have had pleasure in collecting for him.[24]

Linnaeus himself referred to 'the North's light', the North (*Norden*) and the 'Norland', the latter referring to the north-western coast of the Scandinavian peninsula in northern Norway. Linnaeus was not referring to 'Baltic' regions. On the contrary, he identified himself and his fellow philosopher Gunnerus in a common, Northern context.

2. Nordic Enlightenment science

2.1. University conservatism alongside progressive and useful science

Both Sweden and Denmark-Norway experienced short respites from absolutism during the Enlightenment; Sweden, with its Age of Liberty from 1719 to 1771 in which power shifted from the Monarch to parliament, and Denmark-Norway with radically progressive reforms from March 1771 to January 1772. Within these relatively narrow windows, it would be an exaggeration to claim that Nordic politics moved decidedly in a liberal direction

[22]William Clark and others, *The Sciences in Enlightened Europe* (London: University of Chicago Press, 1999), p. 390.
[23]Koerner, *Linnaeus*, p. 34.
[24]Carl von Linné and James Edward Smith, *A Selection of the Correspondence of Linnaeus and Other Naturalists: from the Original Manuscripts* (London: Longman, Hurst, Rees, Orme, and Brown, 1821), p. 502.

throughout the Enlightenment. For instance, the Danish absolute monarchy was not abolished until after the Enlightenment, in 1848.

In the context of education, Nordic universities supported the status quo by providing a steady flow of priests to the state Church. Graduation statistics for the years 1732–1788 indicate that Copenhagen University (Københavns Universitet) trained priests for the better part of the Enlightenment period, with 66.7% of graduates listed as having studied theology.[25] A Danish traveller's account from Sweden's university in Uppsala in the early part of the eighteenth century testifies to an education characterized by the rehashing of traditional doctrine:

> The students do not get a proper foundation for their knowledge. The clergy care little for learning, they merely tell the story of Aaron's oily beard, the bigger the beard, the greater the respect. Nothing is gained by learning.[26]

Conservative as Nordic society seemed in some respects, Nordic intelligentsia's symbiosis with a state Church was not necessarily an indicator of conservatism in the realm of science. Clergymen were some of the most ardent supporters of a useful natural philosophy and theologians were well-represented amongst the founders of academies of science. The Royal Danish Academy of Sciences and Letters (*Det Kongelige Danske Videnskabernes Selskab*), for example, was founded in 1742 at the instigation of Professor of Theology Erik Pontoppidan (1698–1764), among others.[27]

Similarly, the learned society *Collegium curiosorum* (later *Kungl. Vetenskaps-Societeten*) was founded in Uppsala by theologian (and, later, bishop) Erik Benzelius, the Younger (1675–1743), in 1710. Years earlier, he had met Gottfried Leibniz (1646–1716) and been impressed by the academy Leibniz founded, *Preussische Societät der Wissenschaften*. By founding a society in Uppsala; Benzelius, the Younger was creating not only a forum for discussing mechanics, physics and mathematics; but an institute which filled a gap for research and development. In the 1730s, the society in Uppsala financed Linnaeus's Lapland journey and collaborated with the French Academy of Sciences in supporting an expedition to Torneå a few years later.[28]

Another academy committed to progressive science was the Swedish Academy of Sciences (*Kungl. Vetenskapsakademien)*. Since its founding in 1739, the Academy had been a hotbed for utilitarianism and the struggle to

[25]Helge Kragh, Peter C. Kjærgaard, and Henry Nielsen, *Natur, Nytte og ånd: 1730-1850, Dansk Naturvidenskabs Historie*, 4 vols (Århus: Aarhus Universitetsforlag, 2005), II.

[26]Hans Ellegren, 'Hvad Nytt Och Nyttigt', *Nova Acta Regiae Societatis Scientiarum Upsaliensis*, Volumen Extra Ordinem Editum (2019), p. 24.

[27]The Royal Danish Academy of Sciences and Letters, 'Our history/timeline', <https://www.royalacademy.dk /en/Om-selskabet/Om-Os/Tidslinje> [accessed 12 April 2023]

[28]Kungl. Vetenskaps-Societeten i Uppsala, 'Kungl. Vetenskaps-Societeten i Uppsala', <https://www.vetenskapssocietetenuppsala.se/en/history> [accessed 20 April 2023]. See also <https://www.vetenskapssocietetenuppsala.se/sv> [accessed 20 April 2023]

combat false beliefs.[29] Through its regular publishing of new scientific findings and discoveries in *Proceedings* (*Handlingarna*) and the bulletins in its *Almanac*; the Academy worked to change Swedish society and alter people's general way of thinking. Lindroth (1967) refers to the Academy's 'deliberate propaganda' to promote the modern, natural sciences, their results and methods.[30]

Several of Sweden's university-based natural philosophers worked to bring economic betterment to their nation-state through science.[31] As mentioned, several of these philosophers conducted their research outside the universities, in societies- and academies of science. At the time of the founding of *Collegium curiosorum*, universities in Sweden and Denmark were primarily educational institutions. Denmark and Sweden's first universities were founded in the fifteenth century and the Royal Academy of Turku was founded in Finland in 1640. Norway's first university was not founded until 1811 but several schools catered to pupils who wished to pass the entrance requirements to study at Københavns Universitet. In 1630, *examen artium* was introduced there as the entrance exam.

Cathedral schools existed as early as 1152 in Norway, and Trondheim Katedralskole was the oldest.[32] After the appointment of rector Benjamin Dass (1706–1775) there in 1735, the school gradually adjusted its curriculum to give academically-inclined pupils a firmer footing, lending more emphasis to classical languages (in particular; Latin, Greek and Hebrew); mathematics, history, and philosophy. Danish-language skills were encouraged and Dass commanded that pupils translate texts from the Latin to a correct and suitable form of written Danish.[33]

In time, both universities and academies in Denmark-Norway and Sweden-Finland would employ and support progressive thinkers, some of whom received royal patronage.[34] The career of economist and botanist Carl Linnaeus falls into the category of progress-driven science that enjoyed state support. Linnaeus held professorships at Uppsala University, and his research also enjoyed financial support from Sweden's Queen Lovisa.[35]

[29]Sten Lindroth and Kungl. Svenska Vetenskapsakademien. *Kungl. Svenska Vetenskapsakademiens Historia 1739-1818,* 3 vols (Stockholm: Kungl. Vetenskapsakademien, 1967), II, p. 39.

[30]Sten Lindroth and Kungl. Svenska Vetenskapsakademien. *Kungl. svenska vetenskapsakademiens historia 1739-1818,* 3 vols (Stockholm: Kungl. Vetenskapsakademien; 1967), I, p. 111.

[31]Koerner, *Linnaeus*, p. 104. In multiple Uppsala University lectures after 1741, Linnaeus linked Sweden's economy to a knowledge of nature that is adapted to man's needs. See also reference in Koerner, p. 107, to Sweden's first professorship in cameralism, in 1741: 'On Linnaeus' instigation, additional professorships were endowed in what he termed "practical economics, based on natural science"'.

[32]Kragh, Kjærgaard, and Nielsen, p. 25.

[33]A.E. Erichsen, *Trondhjems katedralskoles historie* (Trondhjem: I kommission hos F. Brun, 1911), pp. 155–58.

[34]*Anticipating the Wealth of Nations* (Abingdon: Taylor & Francis, 2011), eds. M. Jonasson, P. Hyttinen and P.C. Hogg <https://www.routledgehistoricalresources.com/economic-thought/books/anticipating-the-wealth-of-nations> [accessed 11 April 2023]. Anders Chydenius (1729–1803) of Royal Academy of Turku advocated economic liberalism and wrote a pamphlet on the invisible hand before the release of *The Wealth of Nations*.

[35]The queen founded the Royal Swedish Academy of Letters, History and Antiquities in 1753. Merit Laine, 'Lovisa Ulrika, drottning', in *Svenskt kvinnobiografiskt lexikon* <www.skbl.se/sv/artikel/LovisaUlrikadrottning> [accessed 1 April 2023]

Clergymen and other theologians who practised natural philosophy are included here amongst the agents of a Nordic Enlightenment science. In Norway, Bishop Gunnerus was such an agent, collecting much of his research data while undertaking expeditions across a diocese that spanned Romsdal in the south of Norway to Norway's northern border to Russia.[36] For Sweden, Koerner highlights the role of the parson as mediator of Linnaeus' scientific activity. She cites the famous botanist:

> The Gentlemen Graduates become most all of them Parsons, spread over the entire country, mostly in the Countryside … . The common Man's inclination and money don't allow him to do experiments; but [he] copies everything that he sees in his Church that his Parson succeeds with.[37]

Linnaeus' reflection on Sweden's common man has its parallel in the eighteenth century Norwegian churchgoer, often a farmer, who typically heeded the advice of the local 'potato pastor' (*potetprest*) and diversified his crops by cultivating potatoes. The potato pastor was equally (or more) intent on circulating agricultural and other practical knowledge, as he was on teaching the word of God.

While many Nordic, natural philosophers had a professional affiliation to a state-controlled Church; others, like Swedenborg, were employed in the civil service. Before writing some 30 volumes about the Bible and what he claimed to have seen and heard in the spirit world, Swedenborg enjoyed a career spanning 30 years as assessor at the Royal Bureau of Mines, a regulatory body overseeing the Swedish state's copper and iron industries. His detailed accounts of iron and copper works received reviews across learned Europe and were dispatched to London by the British ambassador in Sweden.[38]

Nordic monarchs sponsored academies of science and served as patrons to certain philosophers, so that the latter might promote and practise useful science for the benefit of their fatherland. In a speech from 1767, Bishop Gunnerus inaugurated the Royal Norwegian Society of Sciences and Letters (DKNVS) and acknowledged the King's birthday and his Royal Affirmation of the academy's statutes. Gunnerus also used the occasion to pay tribute to Enlightenment philosophers like Isaac Newton, R.A.F. Réaumur, Carl Linnaeus and William Derham; and fleshed out his view on the value of rational thought:

> Without rational ideas, we would think, judge and reach conclusions just as a child would learn to walk; without knowing the rules by which they should abide. They trip, fall and stumble multiple times, when they are not led by another.[39]

[36]Brenna, p. 145.
[37]Koerner, *Linnaeus*, p. 107.
[38]Simon Schaffer, 'Swedenborg's Lunars', *Annals of Science*, 71 (2014), 2–26 (p. 23).
[39]Johan Ernst Gunnerus, *Første Tale, Handlende Om Nytten Og Nødvendigheden Af Et Videnskabers Selskab i En Stat, i Særdeleshed i Norge, Holdet Ved Selskabets Høitidelige Indvielse, Paa Hans Kongelige Majestæts Høie Fødsels-Fest, Den 29. Januarii 1768* (Kiøbenhavn: Pelt, 1768), p. 6.

In Gunnerus' eyes, it was an academy's ability to practise useful science that decided whether it had a *raison d'être* or not:

> Nothing, highly honoured audience, could be more correct, or easier to demonstrate; than the fact that an academy of science is essentially for the use of the State. Should such an academy not be useful; then neither will the Sciences, with which it [the academy] naturally engages, be counted among things useful in a State.[40]

Fellow DKNVS member, Johan Daniel Berlin (1714–1787), was the epitome of the natural philosopher practising science for the good of the public. In 1777, Berlin led the construction work on Trondheim's first waterworks and it was Berlin who constructed its intake dam.[41] A natural consequence of his skilled management in this context was that he was appointed water inspector. Neither clergyman nor theologian during his long career in Trondheim, Berlin was nonetheless employed by the state Church throughout his professional life. From 1740 until his death, he was organist at respectively Nidaros Cathedral and the Church of Our Lady, in Trondheim. His musician appointments, coupled with civil positions as captain of the fire station and inspector of the city's waterworks; secured him a sizeable income. The income of the waterworks inspector position alone was 150 Riksdaler, a sum that allowed Berlin to compose music and engage actively in the DKNVS in his spare time.[42]

2.2. National differences with respect to experimental science

Nordic countries' understanding of the physical universe manifested itself differently during the Enlightenment. The extent to which a Nordic country had a university- or laboratory tradition partly illustrates this. (Outside of the Nordic region, for instance, in England, much of eighteenth-century thought revolved around the idea that the physical universe is understood through mathematics, experiments, and reference to mechanical laws that originated from a supernatural being.[43])

In Sweden, efforts to better understand the physical universe can in part be examined in the context of their experimental sciences. Sweden established its first chairs in physics and chemistry at the University of Uppsala in 1750 and Samuel Klingenstierna (1698–1765) held the first professorial chair in physics. His career illustrates the institutionalization of experimental sciences and the influence of experiments in Sweden's early-modern physics.

[40] Johan Ernst Gunnerus, *Første Tale, Handlende Om Nytten Og Nødvendigheden Af Et Videnskabers Selskab i En Stat, i Særdeleshed i Norge, Holdet Ved Selskabets Høitidelige Indvielse, Paa Hans Kongelige Majestæts Høie Fødsels-Fest, Den 29. Januarii 1768* (Kiøbenhavn: Pelt, 1768), pp. 5, 6.

[41] Trondheim kommune, 'Damkonstruksjoner som forvaltes av Trondheim kommune' <https://www.trondheim.kommune.no/dammer/> [accessed 12 April 2023]

[42] Kari Michelsen, 'Komponist, Offentlig tjenestemann og Organist Johan Daniel Berlin' in *Store Norske Leksikon* <https://nbl.snl.no/Johan_Daniel_Berlin> [accessed 11 April 2023]

[43] Margaret C. Jacob, *The Radical Enlightenment: Pantheists, Freemasons and Republicans*, 2nd edn rev. (Lafayette: Cornerstone Book Publishers, 2006).

(Incidentally, Klingenstierna's understanding of experimentation had far-reaching influence. An essay he wrote on how one could do away with chromatic aberration, was read by the British maker of optical and astronomical instruments, John Dollond (1707–1761). The essay moved Dollond to construct an achromatic (non-colour-distorting) lens for use in a telescope.)[44]

Klingenstierna's career also illustrated the fact that scientists trained in physics and chemistry – both sciences with experimental traditions – could find gainful employment in Sweden's civil service. When the Swedish government founded the Bureau of Mines in 1637, one of its first tasks was to establish a 'chamber of assaying', in which minerals of the various mining sites of Sweden's realm were investigated.[45]

A state-financed Royal Bureau of Mines promoting useful and progressive chemistry is not incompatible with the fact that the most influential early-modern chemists in Sweden were Paracelsists who held on to the ancient idea of the four elements (earth, air, water, and fire). Urban Hjärne's (1641–1724) career illustrates this. A personal acquaintance of Robert Boyle (1627–1691) and fellow member of the Royal Society of London, Hjärne was made head of Sweden's first chemical laboratory in 1683, by royal decree.[46] Hjärne may have belonged to 'the backwater of history as a theoretician', but he was progressive as an experimentalist.[47]

Compared with Sweden, Norway seemed decidedly lacking in experimental scientists. However, Norway's experimental science was not without its advocates. Danish-Norwegian mathematician (Norway's first career mathematician) and meteorologist Diderich Fester's (1732–1811) article from 1788 in the *Proceedings* of the DKNVS, lamented people's prejudice against experiments as being a feeble and insignificant enterprise.[48] To counter such prejudice, Fester presented the art of experimentation as something so difficult, as to be reserved for alert geniuses:

> However, one can with the utmost justification claim that this is a matter of utmost difficulty; it requires much knowledge, much wisdom, great caution, an alert genius; all this requires that one is endowed with sufficient grounds of proof; that one rejects all bias and idiosyncratic opinions.[49]

[44]Sten Lindroth, 'History of Science in Sweden', *Isis*, 36 (1945) 16–19 (p. 17) <http://www.jstor.org/stable/225672> [Accessed 11 April 2023]
[45]Hjalmar Fors, *The Limits of Matter: Chemistry, Mining, and Enlightenment* (Chicago, IL: University of Chicago Press, 2015) <https://search.ebscohost.com/login.aspx?direct=true&db=nlebk&AN=796788&site=ehost-live> [accessed 11 April 2023], pp. 44 and 48.
[46]Bertil Åberg, 'Urban Hiaerne—The first Swedish chemist', *Journal of Chemical Education*, 27 (1950), p. 335 <https://pubs.acs.org/doi/10.1021/ed027p334> [accessed 11 April 2023]
[47]Edwin M. Gusenius, 'Beginnings of Greatness in Swedish Chemistry: Georg Brandt, (1694-1768),' *Transactions of the Kansas Academy of Science*, 70 (1967), 413–25. <https://doi.org/10.2307/3627593> [accessed 11 April 2023]
[48]Rolf Grankvist, 'Matematiker og Navigasjonslærer Diderich Fester' in *Store norske leksikon* <https://nbl.snl.no/Diderich_Fester> [accessed 11 April 2023]
[49]Diderich Christian Fester, *Betragtning over Den Nødvendige Forsigtighed, Som Naturforskeren Maae Iagttage Ved at Anstille Forsøg* (Kiøbenhavn: I Christian Gottlob Prosts Forlag, 1788), 470–92 (pp. ii, iii).

Norway, like Sweden, had a mining industry throughout the Enlightenment period; something which potentially might have encouraged experimental sciences. Kongsberg Sølvverk (1623–1958), the first silver mine in Norway to be in continuous operation, was one of the largest silver mines in Europe. In 1757, the Kongsberg School of Mines opened as an academic institution for mining technology and a separate laboratory was established there for teaching purposes in 1786. As early as 1801, a voltaic pile was constructed for use in the laboratory. This was less than two years after Italian scientist Alessandro Volta (1745–1827) published his experiments on the first electrical battery that could continuously provide an electric current to a circuit. However, Norway was relatively late in acquiring its first university and accounts of experiments in laboratory settings in Enlightenment Norway seem few and far between in the literature.[50] Not so in the case of observational science, for here we find several natural philosophers in Norway who were strongly committed.

2.3. Observational science and northern lights

During the eighteenth century, observational science was viewed as a central tool in scientific conjecture. It was not until the 1820s that influential scientific writers started reframing observation as a passive activity which could be entrusted to untrained assistants, and treating experiment as something that demanded 'ideas and ingenuity on the part of a creative researcher'.[51]

One of the phenomena that was viewed as worthy of scientific observation and, viewed by some Nordic scientists as uniquely Nordic, was the aurora borealis. In Iceland, the oldest known written source on the northern lights was the work 'Description of Iceland' from 1588 to 1589. Attributed to Icelandic Bishop of Skálholt, Oddur Einarsson (1559–1630), the work both testified to use of the word 'norðurljós' (northern lights) and to Icelanders' early interest in the phenomena.

Guðmundsdóttir (2019) discusses early-modern interest in northern lights in the context of weather forecasting. Icelanders predicted the weather according to the colour and sound of the northern lights; something Guðmundsdóttir in part attributes to the writings of German lawyer and naturalist Johann Anderson (1674–1743): 'Beautiful and skipping northern lights he says portend energetic storms or great frost'.[52]

In a work on the natural history of Iceland, published in English in 1758; two chapters are devoted to meteorological observations made at Bessested, Iceland,

[50]Bjørn Pedersen, *Syv bidrag til norsk kjemihistorie. Med artikler av Ragnar Bye og Rolf Manne* (Oslo: Skolelaboratoriet i kjemi. Universitetet i Oslo, 2007), p. 70. Norway received its own professor in chemistry and physics, in 1814.

[51]Lorraine Daston and Elizabeth Lunbeck, *Histories of Scientific Observation* (Chicago, IL: University of Chicago Press, 2011), pp. 3, 104.

[52]A. Guðmundsdóttir, 'Of Wavering Flames and Fires: Northern Lights in Icelandic Sources', *Arv*: *Tidsskrift för Nordisk Folkminneforskning* (2019), 95–128 (p. 99).

between 1 August 1749 and 31 July 1751. In chapter 116 are tabular data from all days of the months, featuring numerical and other symbolic data on wind direction, barometric- and thermometer readings, and indicators to the presence or non-presence of 'North light'. The chapter also included descriptions of winds, clouds and precipitation.[53]

Electricity was another context in which natural philosophers studied aurora borealis. The eighth volume of *The Edinburgh Encyclopaedia: Divination* (1830) features Torbern Olof Bergman's (1735–1784) 'TABLE shewing the heights of the Aurora Borealis.' Bergman was associate professor of mathematics at the University of Uppsala in 1761, and later, professor of chemistry there.[54]

I mention Bergman's table as it signified more than mere data collection; the table was used to exclude some hypotheses and hatch new ones, to paraphrase Daston and Lunbeck (2011). The sightings recorded in Bergman's table span from 12 September 1621, when the aurora borealis was observed in Peinier, to 18 August 1783, when two observations were made and recorded in Kendal and Keswick. Bergman's table was cited by Brewster (1830) to demonstrate that the aurora borealis, while taking place at such heights above the earth's surface that the regions in which it is formed might be highly charged with electric matter; nonetheless failed to impart electric charge in an unusual degree to the lower strata of the atmosphere. Neither the existence nor non-existence of an unusual degree of electricity in the atmosphere during an aurora borealis, reasoned Brewster, could be used as an argument against or in favour of its electrical origin.[55]

When the French natural philosopher Jean-Jacques Dortous de Mairan (1678–1771) published his *Traité physique et historique de l'Aurore boréale* in 1733 without obtaining observational data from Norway, Nordic natural philosophers made their irritation known. The following quotation is from the author's preface of the 1755 work (published in English) *The Natural History of Norway,* published by Danish theologian and Bishop of Bergen Erich Pontoppidan (1698–1764). Mention of the diocese of 'Drontheim' is a reference to the diocese of Trondhjem.

> Had M. de Mairan taken care to procure from Norway, some accurate observations on the Aurora Borealis, his valuable Traité Physique de l'Aurore Boreale, had been

[53]Niels Horrebow, *The Natural History of Iceland: Containing a Particular and Accurate Account of the Different Soils, Burning Mountians, Minerals, Vegetables, Metals, Stones, Beasts, Birds, and Fishes : Together with the Disposition, Customs, and Manner of Living of the Inhabitants : Interspersed with an Account of the Island, by Mr. Anderson … : To Which Is Added, a Meteorological Table, with Remarks. Printed for A. Linde … [and 8 Others]* <https://wellcomecollection.org/works/w2pzugre> [12 April 2023], 145–203.

[54]Britannica, The Editors of Encyclopaedia, 'Torbern Olof Bergman' in *Encyclopedia Britannica* <https://www.britannica.com/biography/Torbern-Olof-Bergman > [accessed 27 March 2023]

[55]David Brewster, *The Edinburgh encyclopaedia*, v.8. (Edinburgh: Blackwood, 1830), p. 494, <https://books.google.no/books?id=ch4SaPz4wB8C&pg=PA493&lpg=PA493&dq=horrebow+northern+lights+1760&source=bl&ots=7jsEh2jWlX&sig=ACfU3U3JpP9hMlROnUnWM1zrNZmWY1shpQ&hl=en&sa=X&ved=2ahUKEwj4srfoucX9AhXU_ioKHRS0AF4Q6AF6BAgoEAM#v=onepage&q&f=false> [accessed 27 March 2023]

much more complete and decisive; for the north light takes its rise from Norway, and particularly from the diocese of Drontheim.[56]

2.4. Literary platforms, clubs and varying degrees of censorship

A significant decentralization of censorship practices took place from 1737 onwards, in the Dano-Norwegian realm, and this would ultimately be a driving force for Norway's Enlightenment science.

Prior to 1737, it was time-consuming for printers in regions and towns far from Copenhagen to ensure prior censorship of written material. Danish law required that any text intended for print must first be sent to Copenhagen and subsequently be reviewed by a professor at Københavns Universitet. This seemed unreasonable when the material in question was random texts, like verses intended for a funeral or wedding. A ceremony might be over before authorities in Copenhagen approved of such verses.

Things would soon change. In 1737, two printers in the provincial, Danish town of Viborg received (by way of royal command) partial exemption from the rule of centralized censorship. A consequence was that much of a printer's planned, printed matter (like verses and orations) could be sufficiently approved by the local bishop, a lecturer or rector. In 1740, Trondheim became the first provincial town in the Dano-Norwegian realm to be granted local autonomy, relative to Københavns Universitet, in censoring literary works, in general. This extension of powers meant that the Trondheim bishop, at his own risk, decided whether he alone would approve the printing of a work; or send it to Copenhagen for further, central control. His censorship authority at this stage was restricted to matter printed at Jens Christensen Winding's (1704–1783) printing press.

In parallel, academies of science would soon enjoy royal protection and be granted the right to publish their own *Proceedings* without the need of imprimatur from Københavns Universitet and without being restricted to one printing press. In 1745, the Royal Danish Academy of Sciences and Letters published its *Proceedings* without any prior authoritative approval from an external source.[57] In 1762 in Trondheim, the DKNVS was granted

[56] *The Natural History of Norway: Containing, A Particular and Accurate Account of the Templerature of the Air, the Different Soils, Waters, Vegetables, Metals, Minerals, Stones, Beasts, Birds, and Fishes; Together with the Dispositions, Customs, and Manner*. 1755. p. xv. Per Pippin Aspaas attributes the cited passage to Jens Christian Spidberg (1684-1762) who apparently stated the passage in a letter, the passage from which was quoted in Pontoppidan's author's preface. See Aspaas' biographical introduction on page 3 in vol. 5 (2017): *Jens Christian Spidberg: Historische Demonstration und Anmerckung über die Eigenschafften und Ursachen des so genandten Nord-Lichts* (1724) / (1728).

[57] Jakob Maliks and Norges teknisk-naturvitenskapelige universitet Institutt for historie og klassiske fag, 'Vilkår for Offentlighet: Sensur, Økonomi Og Transformasjonen Av Det Offentlige Rom i Danmark-Norge 1730-1770' (unpublished doctoral thesis, NTNU, 2011), pp. 99–101, 117. The royal order of 4. October 1737 left it to the discretion of the local bishop, lecturer or rector to review and approve/not approve the printing of verses and orations and similar matter. However, theological, historical, philosophical and medical books would still need be sent to Københavns Universitet for censorship.

imprimatur privileges to approve of any DKNVS *Proceedings* or book, regardless of where it was printed. Henceforth, DKNVS and its leader Bishop Gunnerus could aspire to reach a wider audience by printing *Proceedings* in Denmark, without being bogged down by ´more-or-less expedient censors in Copenhagen'.[58]

When Denmark's King Christian VII gave *Det Trondhiemske Selskab* royal confirmation of its statutes in 1767, elevating it to the Royal Norwegian Society of Sciences and Letters (DKNVS); he did so in the context of persisting censorship of expressions related to the King and religion. Denmark-Norway's king was here in line with other enlightened despots of the eighteenth century.[59] In spite of this autocratic backdrop, the previously mentioned devolution of censorship powers had an apparent effect for Enlightenment activity at a local level:

> The unique, local, censorship autonomy that the town and bishop of Trondheim attained by way of the privileges granted via Winding's printing press; was one of the prerequisites for the burst of intellectual activity taking place in the town throughout the 1750s and 1760s.[60]

Inside and outside of Gunnerus' diocese, enlightened ideas were channelled through letters, periodicals, books, clubs and societies. For example, Thomas Paine's (1737–1809) radical ideas in *The Age of Reason* were made known to the Dano-Norwegian reading public through translations published in 1795 in the learned journal *Politisk og Physisk Magazin*.[61] Norwegian author, Ludvig Holberg (1684–1754) wrote a satirical, fantasy novel *Niels Klim's Underground Travels* about a subterranean universe where gender roles are reversed and inhabitants enjoy religious freedom. Holberg's book was written in Latin and partly published in Leipzig in 1741. Being written in Latin arguably eased translation at the time (the book was quickly translated into German, English, French and Danish) and the choice of publishing site had the effect of avoiding Danish censorship.[62]

Freedom from censorship would later become the norm, thanks to the efforts of Johann Friedrich Struensee (1737–1772), a Prussian-born doctor educated at the University of Cambridge, who later became *de facto* ruler of Denmark-Norway. From 1770 to 1772, Struensee ruled on the King's behalf and abolished

[58]Maliks and Norges teknisk-naturvitenskapelige universitet Institutt for historie og klassiske fag, pp. 140, 142. DKNVS founders Johan Ernst Gunnerus, Gerhard Schøning and Peter Friderich Suhm applied to *Kanselliet* in 1762, for the licence granted in 1762.

[59]Rolv Nøtvik Jakobsen, *Gunnerus og Nordisk Vitskapshistorie* (Oslo: Scandinavian Academic Press, 2015).

[60]Maliks and Norges teknisk-naturvitenskapelige universitet Institutt for historie og klassiske fag, pp. 139–40.

[61]Ellen Krefting, Aina Nøding, and Mona Ringvej, *Eighteenth-Century Periodicals as Agents of Change: Perspectives on Northern Enlightenment* (Leiden: Brill, 2015), p. 75.

[62]Florian Schaffenrath and Alexander Winkler, *Neo-Latin and the Vernaculars: Bilingual Interactions in the Early Modern Period* (Leiden: Brill, 2017), pp. 72, 73. See also Maliks, pp. 93, 107 on the founding of a supervisory organ for censorship, GKIK. The decree of 23 September 1740 encouraged vigilance against booksellers who imported separatist, religious books which were written in Danish and German languages, but which originated from foreign places.

censorship until it was reinstated in 1799.[63] The opportunity afforded by Struensee's progressive reforms was seized upon by county governor of the Norwegian district of Romsdal (in Gunnerus' diocese), Even Hammer (1732–1800).[64] Hammer's writings reflected a belief that the wealth of a nation derived from the value of its land agriculture and land development. On the title page of his treatise, 'Pro Norway: Well-intentioned thoughts for well-thinking fellow citizens', Hammer commended Struensee for allowing Norwegian subjects to 'dare to think and write freely without any slavish Fear,' so they might embrace 'Freedom, within the bounds of reason'.[65]

Clubs were another arena for expounding progressive, even nationalist, views during the Nordic Enlightenment. More than 30 clubs were founded in Denmark-Norway between 1772 and 1820. The Norway Club (*Norske Selskab*), founded by students and other academics in Copenhagen in 1777, was self-organized, unlike other societies which were created on orders from above and organized through the state or a finance elite. Bliksrud (1999) argues that the Norway Club, along with other clubs and societies in Copenhagen, were created in the same spirit as their English and French counterparts.[66] Outside of Denmark-Norway, the Nordic Society in London (*Det nordiske Selskab i London*) was founded in 1786 by British-born, Norwegian merchant John Collett (1758–1810)[67] with the purpose of enlivening and maintaining a love for its members' Fatherland.

Several signs point to a significant, intellectual influence from England, during this time. Trondheim's newspaper *Tronhiems Adresse-Contoirs Efterretninger* published highlights from the Royal Society's *Philosophical Transactions*, during the years 1771–1772, something which points to a link between Norway and England's scientific communities.[68] Moreover, the catalogue of Danish literary historian Rasmus Nyerup (1759–1829) reveals that the library holdings in the DKNVS (spanning from the Society's beginnings until 1806) featured works in British natural philosophy- and scientific journals, published before 1799. One DKNVS library-holding category is titled 'Encycopædier, Methodologier, lærde Selskapers

[63]Gina Dahl, *Books in Early Modern Norway* (Leiden: Brill, 2011). On p. 116, Dahl writes of Struensee that his ' … support for a free press led to a significant growth in the printing of books, periodicals, magazines and so forth, many of which were written in a polemical tone critical of the official politics of the day'.

[64]Arne Apelseth, 'Embedsperson og Forfatter Even Hammer' in *Norsk Biografisk leksikon* <https://nbl.snl.no/Even_Hammer> [accessed 12 April 2023].

[65]Sophus A. Reinert, 'Northern Lights: Political Economy and the Terroir of the Norwegian Enlightenment', *The Journal of Modern History*, 92 (2020), 76–115 (p. 96). This is Reinert's translation.

[66]Liv Bliksrud, *Den smilende makten: Norske Selskab i København og Johan Herman Wessel* (Oslo: Aschehoug, 1999).

[67]Alf Collett, *En Gammel Christiania-Slægt: Optegnelser Om Familien Collett Og Christianias Fortid* (Christiania: Cammermeyer, 1883), 376 (p. 188). See also Steinar Supphellen, 'Rational Norwegian Patriotism in the 1780s', *Scandinavian Journal of History*, 32 (2007), p. 377. Else Boye's article 'Entrepreneur John Collett' in *Norsk biografisk leksikon* <https://nbl.snl.no/John_Collett> [accessed 10 April 2023] states the Society's purpose was 'To enliven and maintain a sensible and warm love for the Fatherland, especially among those who reside in foreign places.' Hemstad in Bodensten and others (2018) writes of Professor Frederik Sneedorff's speech of 1792 given to the Nordic Society of London's Norwegian, Danish and Swedish members, on the importance of the three, Nordic realms´ Association ('*Vigtigheden af de tre nordiske Rigers Forening*').

[68]Monica Aase and Mikael Hård, 'Det norske Athen. Trondheim som lärdomsstad under 1700-talets andra hälft', *Lychnos Årsbok för idé- og lärdomshistoria* (Uppsala: Swedish Science Press, 1989).

Verker, samt periodiske Skrifter af blandet Indhold'. Nyerup included in this category items dating from 1630 to 1799 and on page 482 I find listed 'Philosophical Transactions from the year 1700 to the year 1744. Ibid. 9 Voll. Item for 1778. 2 Voll.' in addition to several other English-language titles, like I. Hill's 'Review of the works of the [R]oyal Society of London' which was published in London in 1751.[69]

2.5. Transnationalism alongside nationalism

By pointing to a certain, British influence on Nordic, natural philosophy in the previous section of this paper; I do not downplay the influence of German philosophy. German inspiration for an early, learned society in Uppsala is already mentioned.[70] Wolffianism is another example of a transnational philosophy which enjoyed success at Swedish universities during the 1740s and 1750s. In eighteenth-century Norway, for example, Wolff is portrayed as the undisputed authority on rational ideas and a great systematician who could apply his mathematical method to all of life's and nature's phenomena.[71]

Named in honour of the Prussian philosopher, mathematician and scientist, Christian Wolff (1679–1754); Wolffianism was committed to building philosophical knowledge upon the principle of sufficient reason. According to sufficient reason, all things have a cause and logical justification for their existence. Wolff assigned a weakened role to revelation in matters of theology and wrote optimistically about the human mind's ability to discover metaphysical and ethical truths on its own.[72] Wolff writes in Schneewind (2007) of a human morality disengaged from God:

> Man's free actions become good or bad through their consequences … They are therefore in and of themselves good or bad and are not first made so by God's will. Thus if it were possible that there were no God and the present connection of things still subsisted, the free acts of man would remain good or bad.[73]

Wolffian trust in reason is not to be understood as material or mechanical thinking. Wolff, like several natural philosophers in his day, was engaged in the relationship between the body and soul. For Wolff, the soul had a free will, and this idea of the soul's *spontaneitas* was a 'staple of the Wolffian philosophy'. For Wolff, the soul was immaterial, indestructible and although it was finite when compared to God, the soul remained in a state of awareness after death. Wollf's metaphysical ideas were not viewed as freakish in Enlightened

[69]R. Nyerup and J. Schultz, Catalog over Det Norske Videnskabersselskabs Samlinger, 1 (Kjöbenhavn: Trykt paa Selskabets Bekostning hos Directeur Johan Frederik Schultz, Kongelig og Universitets-Bogtrykkeri, 1808), 481–82.
[70]Andersen and others, *Aemula Lauri*. See also Nøtvik Jakobsen, *Gunnerus og Nordisk Vitskapshistorie*, p. 117, who positions Denmark-Norway's intellectual (scientific) life in the eighteenth century in a German context.
[71]Kragh, Kjærgaard and Nielsen, p. 30.
[72]Simon Grote, 'Wolffianism and Pietism in Eighteenth-Century German Philosophy', *Intellectual History Review* Ahead-of-print (2022): 1–29 (p. 1) <https://doi.org/10.1080/17496977.2022.2117922> [accessed 30 March 2023].
[73]J.B. Schneewind, *Moral Philosophy from Montaigne to Kant* (Cambridge: Cambridge University Press, 2003), p. 335.

Europe. On the contrary, they were part of the essence of Enlightenment thinking, as taught to philosophers, lawyers and physicians.[74]

This begs the question of whether other transnational influences, like the German science of public administration, cameralism, were also at work. Cameralism is relevant as its ideal of a surplus economy ties in with the Enlightenment ideal of useful science. The ideal of useful science has a decidedly national, even patriotic, quality; as opposed to a regional or transnational one. One definition of cameralism is from 1745:

> *Cameral-Wissenschaft* concerns itself with the means of raising revenues for the *Landes-Fürst*, their general improvement and utilization in the maintenance of the commonweal [*gemeinen Wesens*] so that every year a surplus remains.[75]

Cameralism's ideal of a surplus economy was shared by natural philosophers and the ruling elite in Nordic countries, like Sweden. Unlike the economies of the various German principalities, Sweden's economy during most of the Enlightenment was post-imperial. In the context of Sweden's loss of its Baltic colonies after the Great Northern Wars with Russia (1700–1718), Swedish nobility had warmed to economists' and natural philosophers' ideas of less dependency on imports. For example, Sweden's estates (the nobility, clergy, burghers and peasants) financed Linnaeus' 1741 voyage to the Baltic archipelago 'to look for herbs' in the interest of bringing plants from a foreign climate to cultivate at home.[76]

Norway had its own advocates of self-sufficiency. Previously-mentioned Even Hammer favoured self-sufficiency over subjugation to what he dubbed Norway's 'jealous sister' in the double monarchy, Denmark. To gain self-sufficiency, it was vital that Norwegians invest more in their youth and encourage them to learn about trade and related sciences in England, Holland and France, among other countries. Hammer's patriotism was evident. He was critical of Copenhagen's monopoly on university studies and endorsed the building of trade schools and a university in Norway since 'Norway should more than any other Kingdom be the true planting-place for the sciences of nature, mountains, and trade, for mathematics, mechanics, botany, and oeconomy'.[77] Hammer helped found Romsdal's Society for Practical Land-Economy in 1776. To the DKNVS he left behind a library of 570 volumes and bequeathed 30 Riksdaler in his will to DKNVS, of which he long had been a member.

[74]Friedemann Stengel, 'Johan Ernst Gunnerus and the Quest for the Soul in the Eighteenth Century', *Sjuttonhundratal*, 12 <https://doi.org/10.7557/4.3529> [accessed 12 April 2023], p. 138.

[75]Keith Tribe, 'Cameralism and the Science of Government', *The Journal of Modern History,* 56 (1984), 263–84 (p. 264) <http://www.jstor.org/stable/1879090> [accessed 12 April 2023].

[76]Koerner, *Linnaeus*, p. 104. See also Michael Bregnsbo, Patrik Winton and Pasi Ihalainen in *Scandinavia in the Age of Revolution: Nordic Political Cultures, 1740–1820* (Farnham: Routledge, 2011), p. 18. Absolutism in Sweden was abolished in 1718. An 'Age of Liberty' followed, in which royal power was weak. The four estates, and the aristocratic Council of the Realm, became the political centres of importance. Though the state authority still lay exclusively with the king, he could not govern without the advice and consent of the Council or take decisions that were at odds with the privileges and immunities of the estates.

[77]Reinert, p. 96.

3. A natural philosopher's code of ethics and sense of duty

The DKNVS, which Gunnerus co-founded, acquired an international membership base and produced scientific articles in disciplines as varied as botany, mathematics, and early-modern meteorology in *Skrifter*. Despite this, and despite Gunnerus' contributions to botany and natural history in a Republic of Letters; the historiography of Norwegian science in the Enlightenment has been saddled with the impression that metaphysics and theology were the main driving forces behind the DKNVS. Gunnerus' priorities have been described as the 'theological and apologetic value of natural science research, the relationship between the body and the soul, the freedom of individuals, the two outcomes after death … scientific societies and collecting'.[78] This is reasonable since Gunnerus wrote on the immortality on the soul and worked within a theologian context. Yet I am more interested in how he and other natural philosophers in Norway pursued intellectual goals separate from the metaphysical, and from interpreting religious texts.

Such goals included a desire to fulfil one's Christian duties, engage in science according to convention and promote progress. The DNKVS' journal *Proceedings* promoted scientific activity as a goal, and the journal itself resulted from Bishop Gunnerus' desire that natural philosophers put their findings to writing, for dissemination to a scientific community.

Linked to the desire to share one's findings is the natural philosopher's need to follow conventions. A scientist must balance his personal interest in staking a claim to scientific priority with that of distributing scientific credit fairly. Olof Hiorter (1696–1750), once Sweden's Astronomer Royal and Director of the Uppsala University Observatory, is credited with the discovery (in 1747) of the magnetic effects of the aurora borealis.[79] Hiorter was given sole responsibility for investigating the diurnal changes in the direction of the Observatory's magnetic needle. He produced a total of 6638 observations, using a very convex glass, by candlelight. Yet he took pains to give credit to astronomer Anders Celsius (1701–1744), who invested money in the instruments Hiorter had used to make his discovery and to acknowledge astronomer Edmond Halley's (1656–1742) paper on the 1716 Aurora, seen throughout Europe that same year. Hiorter's own reason for quoting Halley seemed to be to prevent the English from calling him a plagiarist, 'like they are usually prone to do'.[80] Hiorter's attention to authorship has been linked by others to technical competence (including the capacity to work hard) and scientific autonomy; and his attempts at fairness in distributing scientific credit have been linked to a sense of Christian duty.

[78]Rolv Nøtvik Jakobsen, 'Johan Ernst Gunnerus – A Conservative Theologian and an Enlightened Scientist (?)', *Det Kongelige Norske Videnskabers Selskabs Skrifter* (2011), 75–108 (p. 75).
[79]Sven Widmalm, 'Auroral Research and the Character of Astronomy in Enlightenment Sweden', *Acta Borealia*, 29 (2012), 137–56 <https://doi.org/10.1080/08003831.2012.732282> [accessed 12 April 2023]
[80]Widmalm, p. 141.

Natural philosophers acting in a Republic of Letters also negotiated scientific credit, amongst themselves. The following quotation from a letter from Linnaeus to Ellis proffered a distribution of credit for the discovery of a plant genus. The letter was not dated but the London post-mark is Nov. 4 and the year is presumed to be 1760. Linnaeus gave the name of Gardenia to a new and 'very singular' genus and wrote to his friend Ellis: 'All that I beg of you, my dear friend, is, that you would publish the genus and its character in some loose sheet, or some periodical work, or transactions; in which case I promise to adopt the name.' [81]

4. Norway's climate scientists: example of enlightenment science

To show some of the ways in which Norway belonged to a European community of science in the eighteenth century, I cite works of two clergymen Hans Strøm (1726–1797), Jacob Nicolai Wilse (1735–1801) who worked in rural settings; and of two non-clergy, urban cosmopolitans Johan Daniel Berlin (1714–1787) and Diderich Fester (1732–1811). All four followed European conventions of scientific-article writing, had access to European, scientific works; participated in a network of scientific collaboration, and were abreast of contemporary instrumentation practices in Europe.

These men devoted years of their lives to practicing climate science.[82] This begs the question of why. Did it have something to do with their wanting to carve out a climate science that was quintessentially Norwegian? Patriotic fervour existed amongst Norway's early-modern intelligentsia, as we witnessed earlier with the rebuke of Jean-Jacques Dortous de Mairan for publishing a work on northern lights without first having procured accurate observations from Norway. Gerhard Schøning (1722–1780) was co-founder of DKNVS, and a Norwegian historian with a keen interest in climatology. Schøning portrayed his countrymen as protectors of virtues like boldness, courage and patriotism; and praised Norway's ancient farmers and fishermen as strong and free.[83]

Nonetheless it seems unlikely that Norway's climate scientists thought of themselves as patriots studying atmospheric-, topographical- and other

[81] Carl von Linné and James Edward Smith, *A Selection of the Correspondence of Linnaeus and Other Naturalists: from the Original Manuscripts* (London: Longman, Hurst, Rees, Orme, and Brown, 1821), p. 136 < https://wellcomecollection.org/works/qz9dz7u5> [accessed 12 April 2023]

[82] Both terms 'meteorology' and 'climate science correctly denote the observational science practised by Wilse, Fester, Berlin and Strøm, who observed and recorded atmospheric, weather data over several decades. Their data was potentially significant for weather forecasting and amassing knowledge of general weather conditions of a place (climate). 'Meteorology' in British-English refers to the study of the earth's atmosphere, especially of weather-forming processes and weather forecasting. The word has seventeenth-century origins and is derived from Greek *meteorolōgia; meteōron* [meaning something aloft] + *-logia* –logy. <https://www.collinsdictionary.com/dictionary/english/meteorology> [accessed 12 April 2023]

[83] Stian Bones Larsen, 'Gerhard Schøning, Gothicism and the Re-evaluation of Northern Landscapes', *Acta Borealia*, 18 (2001) 61–84 (p. 62) <DOI: 10.1080/08003830108580526> [accessed 20 April 2023]. Schøning's work on the climate history of the Trondhjem diocese *Kort beretning om endeel Uaar og Misvæxt, særdeles i Trondhiems Stift i Norge* from 1761 reflects his interest in local and transnational climates.

climate phenomena solely for a Norwegian audience. Scientists in other Nordic countries were also engaged in climate studies and 'climate' was too capacious a term for any one country to claim it for their own. In the eighteenth century, 'climate' encompassed meteorology, a country's topography, geography and altitude; and its natural resources.[84] For example, Sweden's Royal Academy of Sciences financed several expeditions to locate natural resources in various sites in Sweden.

Moreover, climate was viewed as highly dynamic and climate change brought about by human activity was viewed as desirable. The reasoning was that man, by improving his climate, also secured gains for himself and his country.

Norway's population suffered high mortality rates also, largely due to failed crops and subsequent malnutrition during the first half of the eighteenth century. Johan Daniel Berlin's recorded observations of Trondheim's climate between 1762 and 1787, and his inventions; should be viewed in the context of a national desire to increase agricultural output. Berlin's threshing-machine invention, for example, was designed to complete the same amount of labour as nine people working simultaneously.

4.1. The shift from subjective observations to quantitative readings

What Berlin and the other aforementioned climate scientists from Norway had in common was their meteorological research and career-professional relationship to the Church. This was not unique to Norway. In Britain, Anglican clergymen like William Derham (1657–1735) and members of the gentry formed the better part of natural philosophers making meteorological observations. Their observations were typically disseminated in the form of qualitative, subjective reports and until the late eighteenth century, reports of singular, meteoric events made up roughly 57 per cent of all articles published in the *Philosophical Transactions*.[85]

During the last two decades of the eighteenth century, climate scientists moved from chronicling freak or striking atmospheric phenomena; to viewing their science as a quantitative, laboratory-like enterprise. In short, early-modern meteorologists increasingly abandoned the so-called meteoric tradition where the focus had been unusual and singular events in the atmosphere.[86]

In Norway, one finds a similar shift towards quantification and generalization. Jens Christian Spidberg (1684–1708), a Norwegian theologian who was

[84]Carl Frängsmyr, *Klimat och karaktär: naturen och människan i sent svenskt 1700-tal* (Stockholm: Natur och kultur; 2000), p. 197.
[85]Vladimir Janković, *Reading the Skies: A Cultural History of English Weather, 1650–1820* (Manchester: Manchester University Press, 2000), p. 11.
[86]Janković, p. 35.

(towards the end of his life) appointed bishop of the diocese of Christianssand. He was also a prolific natural philosopher, producing works in meteorology in addition to theology and history. Spidberg's (1724) work *Historical Demonstration of, and Commentary on, the Properties and Causes of the so-called Northern Light* is an early example of a natural philosopher presenting atmospheric events over a longer period of time. In this work, Spidberg compiled and published continuous observations of several aurorae over a period of two years; possibly between 1711 and 1714, in southern and central Norway.[87]

Jacob Nicolai Wilse was a Danish-Norwegian parish priest known for his topographical works, and for the weather data he submitted to the Palatine Meteorological Society, based in Mannheim. Wilse also sought out knowledge of meteorological conditions in order to enhance knowledge of plant- and animal life. Wilse's 'Household calendar' presented average temperatures for each day of the year, juxtaposed with observations from plant- and animal life.[88]

Another of Norway's climate scientists, Diderich Fester, came from a modest background in Sjælland, Denmark to Trondheim, to teach mathematics at Trondheim Katedralskole. Fester's significance in the context of this article is his work in climate science, his civil service and professional link to the Church.[89] Between 1788 and 1802, Fester daily recorded observations of pressure, temperature, wind direction and (from 1798) weather. His (and Berlin's) observations, known as the Trondheim series, are published in DKNVS' *Skrifter* and referred to as one of the longest observation series on Earth.[90]

Hans Strøm was pastor in the western town of Volda and later in the south-eastern town of Hokksund. Strøm researched atmospheric phenomena in the hope that a better understanding of the weather could reveal the causes of meteorological changes and perhaps even help people predict these. Strøm wrote:

> Not least, many of our diseases are caused by the nature of the atmosphere, but also a significant share of man's occupations, especially those pertaining to agriculture and seafaring, often meet with serious obstacles. It follows that neither one nor the other of these inconveniences would be so worrisome as they are if we precisely understood the causes and could predict these.[91]

[87]Per Pippin Aspaas, *Historische Demonstration und Anmerckung über die Eigenschafften und Ursachen des so genandten Nord-Lichts (1724)/1728,* Aurorae Borealis Studia Classica, 5 (2017) <https://doi.org/10.7557/absc.2017.5> [accessed 10 April 2023], p. 4.

[88]N.J. Nielsen. 'Videnskabernes Literatur i det nittende aarhundrede', in eds. H. Jæger and O. Andersen, *Illustreret norsk literaturhistorie* (Kristiania: Hjalmar Biglers forlag, 1896), p. 169. <https://www.nb.no/nbsok/nb/218b511ffd1c14cb9e1b95de2c6ad2a7?lang=no#499> [accessed 12 April 2023]

[89]Wilhelm K. Støren and Olaus Schmidt, and Trondhjems Borgerlige Realskole, *Trondhjems Borgerlige Realskole 1783–1956* (Trondheim: Skolen, 1956), p. 37.

[90]B.J. Birkeland, 'Old Meteorological Observations at Trondheim: Atmospheric Pressure and Temperature During 185 Years', *Geofysiske Publikasjoner*, 15 (1949), 5–38. Weather-observation series for Trondheim were issued in DKNVS' *Skrifter* between the years 1762–66 and 1768–71, and in the local newspaper *Tronhiems Adresse-Contoirs Efterretninger* between 1780 and 1802.

[91]Hans Strøm, 'Meteorologiske lagttagelser som fra April 1761. til samme Maaned 1762. ere giordte i Borgensund nær Vesterhavet paa 62. Grad 33. Minuter beliggende.', *D* (1763), 377–405 (p. 377).

In his article on the meteorological observations he made from April 1761 - April 1762, Strøm advocated observing temperature with a thermometer rather than with the senses (Strøm used the word 'feeling' instead of 'senses'):

> I thus perceive this way of measuring certain degrees in the air's pressure [editorial comment: the original Danish word here is *Tyngde*, meaning 'weight'] and temperature [*Varme*, meaning 'heat', in the original Danish] as the noblest sources of its [editorial comment: the air's] other variations, and thereupon make use of the so-called barometers and thermometers, which by the same causes of cold, heat et cetera always show the same effect (as opposed to the feeling, which out here varies greatly) and has the advantage that one can make his experiences known and comprehensible to others[…][92]

Strøm also urged the observer to describe the instruments (the barometer and thermometer) he used and to outline the methods by which he used them. This seems a reasonable request, knowing as we do that barometers enjoyed broad use in Europe and, by the early 1700s, were no longer 'confined to the cabinets of the virtuosi'.[93]

4.2. Norway's climate scientists attuned to international meteorological networks

Climate scientists of the twenty-first century, specializing in the recovery and analysis of data retrieved with early-modern instruments, highlight two international networks in the context of eighteenth-century meteorology; James Jurin's network, which resulted in weather records from Europe and from American colonies being published in *Philosophical Transactions* between 1732 and 1742[94] and the Palatine Meteorological Society, which from 1780 to 1795 boasted a network of 37 weather stations scattered across Europe and the United States.[95] Neither of these networks lasted much longer than 20 years.[96]

Though not expounded further in this article, one explanation for an early-modern interest in climate may lie in the context of human health, as Hippocratic ideas prevailed about the link between the environment (also indoor climate) and the incidence and mortality of diseases. In 1723, the Royal Society of London for Improving Natural Knowledge launched a project to collect meteorological records from weather observers in Europe and North America. The motive for this is recorded in the minutes of an ordinary meeting of the Royal Society from 12 December 1723. It is noted that Dr

[92]Strøm, p. 379.
[93]*The Sciences in Enlightened Europe*, eds. William Clark, Jan Golinski and Simon Schaffer (Chicago, IL: University of Chicago Press, 1999), p. 71.
[94]Paul N. Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge, MA: MIT Press, 2010), p. 33.
[95]D. Camuffo with others, 'Temperature observations in Bologna, Italy, from 1715 to 1815: A comparison with other contemporary series and an overview of three centuries of changing climate', *Climatic Change*, 142 (2017), 7–22 (pp. 1, 2).
[96]David C. Cassidy, 'Meteorology in Mannheim: The Palatine Meterological Society, 1780-1795', *Sudhoffs Archiv*, 69 (1985), 8–25 (p. 9).

James Jurin, then-Secretary of the Royal Society, read a paper entitled 'A Proposal for Joint Observations of the Weather' in which he set forth advantages reaped from having a complete theory of the weather.

The most notable advantage envisioned by Jurin was the improvement of 'the medicinal art', since viral diseases (referred to as 'distempers', in the minutes) were believed to be manifestly affected by the alterations of the weather:

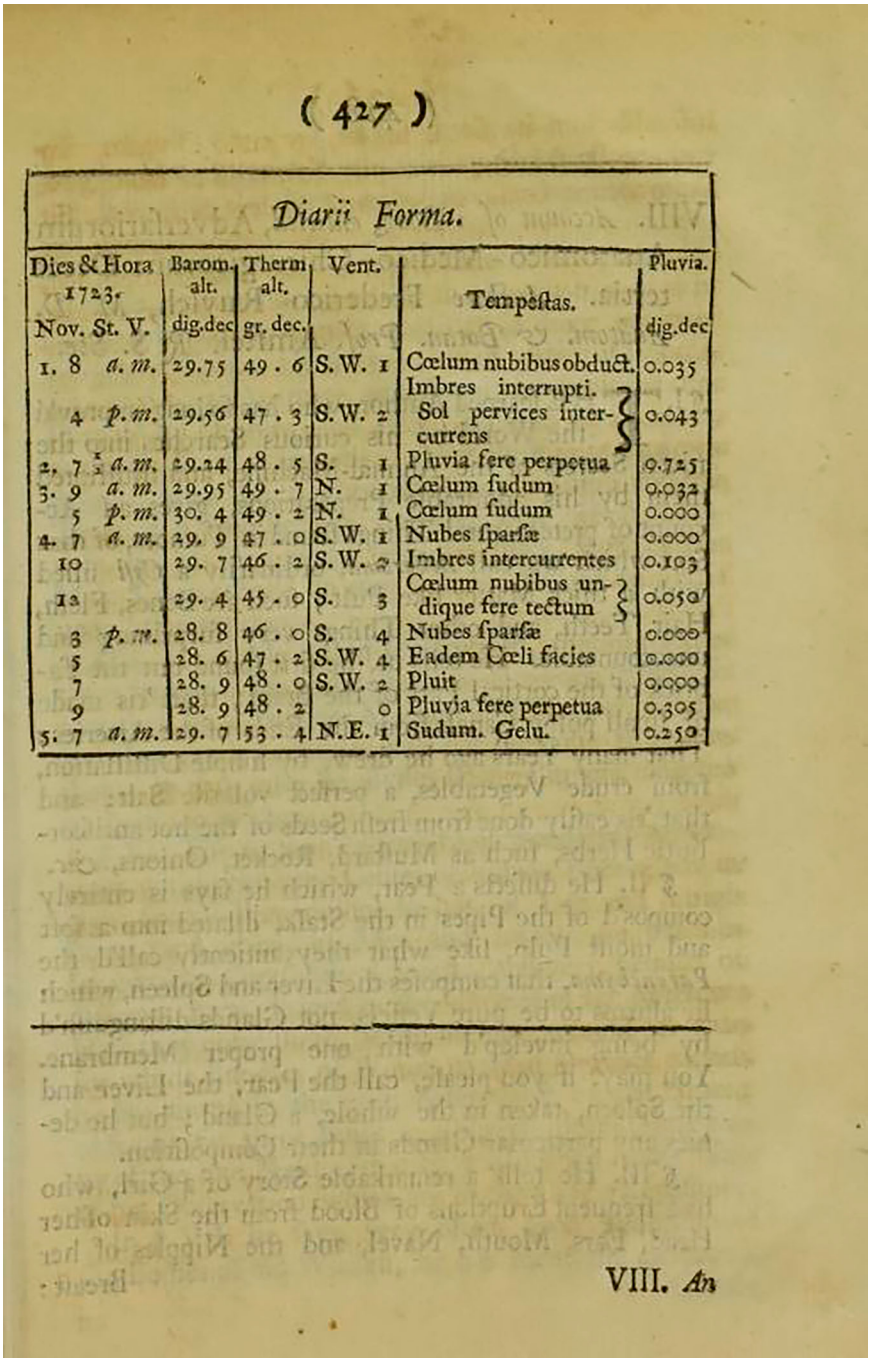
> He next showes that a true theory of the weather is not to be attained by a knowledge of the successive alterations in any one certain place; because the air being fluid the state of it in any one place depends upon the condition of the circumambient air:[97]

Figure 1 shows Jurin's sample table which would help observers use the Society's proposed conventions. The column farthest to the left is reserved for date and hour. The next two are respectively for the altitude of the barometer and the altitude of the thermometer. Wind- direction (*Vent.*) is recorded in the next column. Weather (*Tempestas*) in general is recorded descriptively, for example 'constant sunshine' (sol pervices intericurrens). The last column is reserved for rain (*Pluvia*).

Jurin's network disbanded well before Berlin, Strøm, Wilse and Fester published their own meteorological data. However, it is likely that climate scientists in Norway knew of other transnational networks and audiences, and were oriented towards these in their research. Berlin's systematic measurements of barometric air pressure, temperature and general-climate readings were published in *Skrifter*, both in the German- and Danish languages.

Moreover, some of their published works provide indirect evidence that they adhered to several of the same measurement and instrumentation conventions (for atmospheric observations) that meteorologists outside Norway used. In Berlin's weather observations from Trondheim for 1763 and 1764, for example, atmospheric data are presented in tables for the twelve months of the year; each year with six columns.[98] The first four columns are reserved for quantitative data, the latter two for qualitative entries. From left to right, the column-heading titles read 'Days' (*Dagene*) for days of the month in question, 'Barometer' (*Barom.*) which shows the height of the barometer at a given date, 'Thermometer' (*Therm.*) and 'Wind' (*Vinden*). The wind column appears to be reserved for indications of the wind's direction at a given time, as Berlin has entered abbreviations like S.V. (for *sørvest*, 'southwest' in English), V (for *vest*, 'west' in English), N.V. (for *nordvest*, 'northwest'), O (for *øst*, 'east'), and so on. The fifth column heading is *Veiret om Dagen*, meaning 'Weather during day' and the sixth column is reserved for 'Weather during night'

[97] *Journal Book of the Royal Society 1720–1726,* 13, 12 December 1723.
[98] Johan Daniel Berlin, 'Observat. Af Bar. Therm. Vind Og Veiret, for Aar 1764., I Tronh'., *D. Trondhiemske Selskabs Skrifter* (Kiøbenhavn: Pelt, 1765), 491–514.



(427)

Diarii Forma.

Dies & Hora 1723. Nov. St. V.		Barom. alt. dig.dec	Therm. alt. gr. dec.	Vent.		Tempeſtas.	Pluvia. dig.dec
1. 8	*a. m.*	29.75	49 . 6	S. W.	1	Cœlum nubibus obduct.	0.035
4	*p. m.*	29.56	47 . 3	S. W.	2	Imbres interrupti. Sol pervices intercurrens	0.043
2. 7 ½	*a. m.*	29.24	48 . 5	S.	1	Pluvia fere perpetua	0.725
3. 9	*a. m.*	29.95	49 . 7	N.	1	Cœlum ſudum	0.032
5	*p. m.*	30. 4	49 . 2	N.	1	Cœlum ſudum	0.000
4. 7	*a. m.*	29. 9	47 . 0	S. W.	1	Nubes ſparſæ	0.000
10		29. 7	46 . 2	S. W.	2	Imbres intercurrentes	0.103
12		29. 4	45 . 0	S.	3	Cœlum nubibus undique fere tectum	0.050
3	*p. m.*	28. 8	46 . 0	S.	4	Nubes ſparſæ	0.000
5		28. 6	47 . 2	S. W.	4	Eadem Cœli facies	0.000
7		28. 9	48 . 0	S. W.	2	Pluit	0.000
9		28. 9	48 . 2		0	Pluvia fere perpetua	0.305
5. 7	*a. m.*	29. 7	53 . 4	N. E.	1	Sudum. Gelu.	0.250

VIII. *An*

Figure 1. Volume 32 (1772–1773) of Philosophical Transactions of the Royal Society includes this sample table with the Royal Society 'Invitation to make Meteorological Observations', written in 1722. Image in the public domain: retrieved from Biodiversity Heritage Library.

(*Veiret om Natten*). These columns are reminiscent of the tabular prescriptions made by the Royal Society's Secretary, James Jurin, in London, over 40 years earlier:

> He would have the journal to consist of six columns. The first shows the day of the month, and hour of the Day when the observation was made. The second the height of the Barometer in Inches and Tenths. The third the height of the Thermometer in degrees and decimals. The fourth the point of the Wind, with the degree of its Strength, and the whole extent of its Strength might be conveniently divided into 4 degr. The fifth the State of the Weather as to fair or foul. The sixth and last shows the depth of Rain fallen since the time of the last observation.[99]

Hans Strøm, in his weather observations from Borgensund, Norway; referred to markings on the board (*Tavle* in Danish) onto which his barometer's glass tube was secured, as indicators of 'a Parisian as well as a London foot'. Strøm remarked that '… one has this in the observations used the London [convention], which was the closest one at hand.[100]

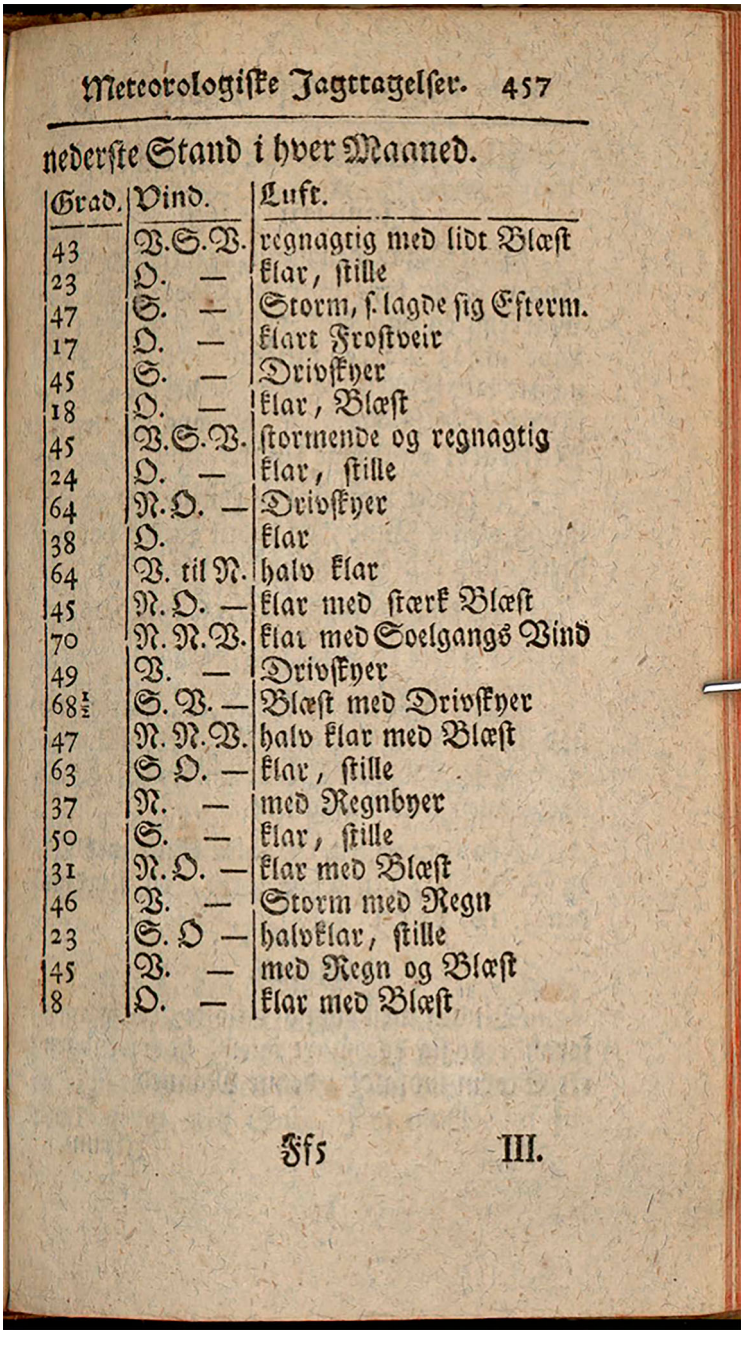
Hence, one may rightly feel perplexed when one reads in the literature that '[…] the fabric of the Society of Trondheim was weaved from other fibers than its French and English counterparts'.[101] A closer examination of the published works of Strøm, Berlin and Wilse shows that Norway's early-modern climate scientists were adhering to yet another convention used by their British colleagues, the recording of extreme values. Strøm's weather dissertation from 1763 contains only two tables, and of the approximately four thousand measurements he made, published only four measurement values from each month. Strøm only reported 84 extreme values out of the possible 4000 values in his weather observations. 4000 measurements were not immediately readable, so Strøm apparently chose those which were most remarkable and which could be categorized. See Figure 2.

The propensity to focus on extreme values was not unique to Norway's Enlightenment meteorologists. British climate scientist Spencer Cowper, Dean of Durham (1746–1774) advertises his 'Thermometrical observations' in terms of a difference in extremities, in the following excerpt from a transcript of a letter he wrote (to an unknown addressee) dated January 17, 1770:

> My Dear Sir,
>
> I have compleated my naturalists Journal for 1769 as well as I cou'd. When Dr Moore returns to Christ-Church I will trouble him with it. In the mean time you may be glad to see the result of the whole. By the Thermometrical observations you will see how very mild our Winters are, or at least of this year; and at the same time how much below par our summers. The Difference of the Extremities being only 20,8.[102]

In Norway, Berlin's observations of temperature and (air) pressure were limited to extreme values (with a few exceptions) for the years 1772–1779.[103] Figure 3

[99]'James Jurin on collecting meteorological observations', *Journal Book of the Royal Society 1720–1726*, 13, 12 December 1723, p. 334.
[100]Hans Strøm, 'Fortsættelse af Meteorologiske lagttagelser i Borgensund for Aaret 1763', *Trondhiemske Selskabs Skrifter*, D (Kiøbenhavn: Pelt, 1765), 453–64 (p. 380).
[101]Andersen and others, p. 18.
[102]Joan M Kenworthy and Margaret S Collum, 'A contribution to meteorology by Spencer Cowper, Dean of Durham 1746–74', *Notes and records of the Royal Society of London,* 63 (2009), 57–80 (p. 73).
[103]Birkeland, p. 6.



Meteorologiſke Jagttagelſer. 457

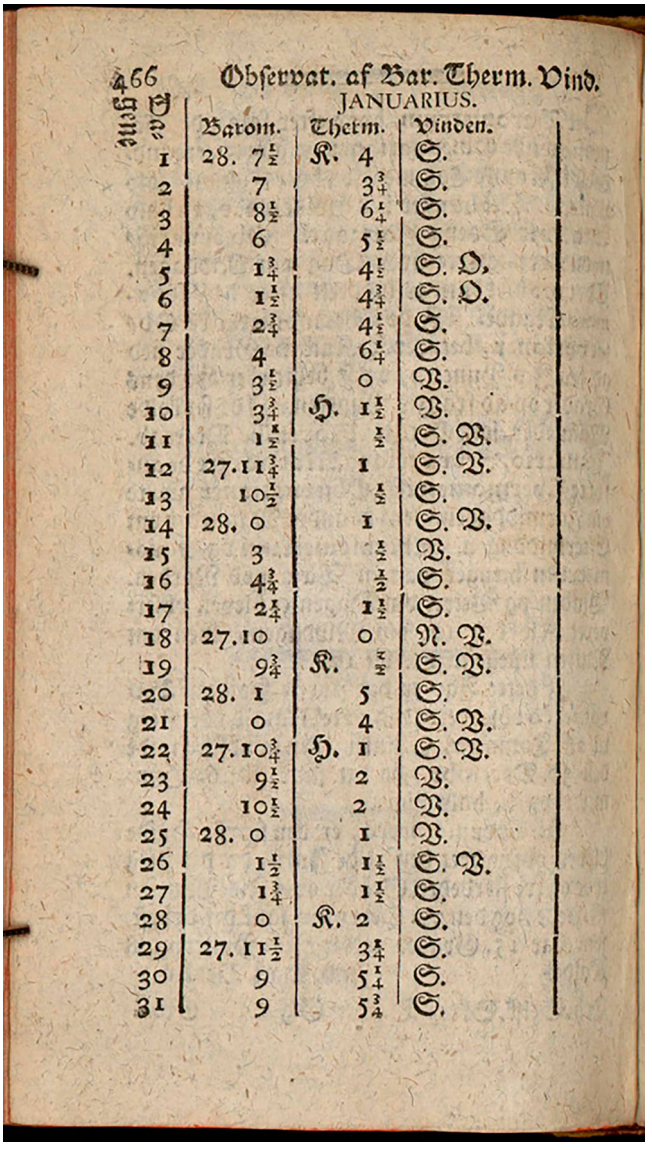
nederſte Stand i hver Maaned.

Grad.	Vind.	Luft.
43	V.S.V.	regnagtig med lidt Blæſt
23	O. —	klar, ſtille
47	S. —	Storm, ſ. lagde ſig Efterm.
17	O. —	klart Froſtveir
45	S. —	Drivſkyer
18	O. —	klar, Blæſt
45	V.S.V.	ſtormende og regnagtig
24	O. —	klar, ſtille
64	N.O. —	Drivſkyer
38	O.	klar
64	V. til N.	halv klar
45	N.O. —	klar med ſtærk Blæſt
70	N.N.V.	klar med Soelgangs Vind
49	V. —	Drivſkyer
68½	S.V. —	Blæſt med Drivſkyer
47	N.N.V.	halv klar med Blæſt
63	S O. —	klar, ſtille
37	N. —	med Regnbyer
50	S. —	klar, ſtille
31	N.O. —	klar med Blæſt
46	V. —	Storm med Regn
23	S.O —	halvklar, ſtille
45	V. —	med Regn og Blæſt
8	O. —	klar med Blæſt

Ff5 III.

Figure 2. Highest and lowest, monthly thermometer readings for Borgensund in 1763, as reported by Hans Strøm in *Skrifter*.

shows observation data tabulated in a manner similar to that prescribed by Jurin, where the first (from the left) column is reserved for the date, the next two columns for barometer and thermometer readings, and information



466 Observat. af Bar. Therm. Vind.

JANUARIUS.

Dage	Barom.	Therm.	Vinden.
1	28. 7½	K. 4	S.
2	7	3¾	S.
3	8½	6¼	S.
4	6	5½	S.
5	1¾	4½	S. O.
6	1½	4¾	S. O.
7	2¾	4½	S.
8	4	6¼	S.
9	3½	0	V.
10	3¾	H. 1½	V.
11	1½	½	S. V.
12	27. 11¾	1	S. V.
13	10½	½	S.
14	28. 0	1	S. V.
15	3	½	V.
16	4¾	½	S.
17	2¼	1½	S.
18	27. 10	0	N. V.
19	9¾	K. ½	S. V.
20	28. 1	5	S.
21	0	4	S. V.
22	27. 10¾	H. 1	S. V.
23	9½	2	V.
24	10½	2	V.
25	28. 0	1	V.
26	1½	1½	S. V.
27	1¾	1½	S.
28	0	K. 2	S.
29	27. 11½	3¼	S.
30	9	5¼	S.
31	9	5¾	S.

Figure 3. Four our columns of weather data for the month of January, with respective headings for values (left to right); Days of the month, barometer, thermometer, wind. (Berlin, 1765).

about wind reserved for a fourth column. (By comparison, Strøm's table in Figure 2 is included in its last column with the heading Luft ('Air' in English) for a description of the sky aspect; where data about clouds, precipitation and wind were recorded.)

In his 1763 observations, Berlin (1765) also included details on how he used the barometer and thermometer. Note his reference to the thermometer setting:

> The barometer, by which the following barometric observations have been made, is divided into French inches, and each inch (divided) by twelve lines. It is hung

> indoors at a height of one half *alen*[104] over the horizon of the hill. The observations are made daily at noon. The thermometer is set according to the fashion of Mr. Reaumur.[105]

Berlin's thermometer used a Réaumur scale. The French aristocrat and naturalist R.A.F. Réaumur (1683–1757) had observed in 1739 that mercury and alcohol thermometers did not produce identical readings throughout their common range, and throughout the Enlightenment, scientists differed in their view of what constituted the right thermometric fluid. Three of the fluids used were atmospheric air, mercury, and ethyl alcohol.[106]

Berlin's barometer, according to climate scientist B. J. Birkeland (1949), was most likely a siphon, mercurial barometer, which he placed in a room on a north wall at 12.9 meter's height (41 Norwegian feet) above sea level. See Figure 4.

After Berlin died in 1787, Diderich Fester carried out his own atmospheric research. Fester's article in *Skrifter* 'Betragning over Luftens almindelige Temperatur' is a contemplation on the average air temperature, but without actual weather data until 1798.[107]

I have shown that at least two of Norway's climate scientists, Strøm and Berlin, were influenced by English and/or French conventions. In the Norwegian parish of Spydeberg, worked another of Norway's natural philosophers, Jacob Nicolai Wilse, who was very much under a German influence, regularly submitting weather data to the Palatine Meteorological Society. The Society required its contributors to only use officially calibrated and adjusted instruments; and to make observations at fixed times in the day: 7 am, 2 and 9 pm These fixed times were later dubbed 'Mannheimer hours', named after the city which housed the Society's office. At the expense of the principality's elector, each associate observer received a thermometer (using a Réaumur scale of minus 17–80 degrees plus), a barometer (using a scale with Parisian inches), a hygrometer and a declinatorium.[108]

Wilse, Berlin and Strøm did not restrict themselves to giving quantitative accounts of the atmosphere. Where numerical values did not do justice to climate phenomena of interest; Norway's climate scientists found other ways

[104]Knut Hofstad, 'Alen' in *Store Norske Leksikon* <https://snl.no/alen> [accessed 12 April 2023]. A directive of 1683 determined an *alen* to be equal to two Rhineland feet (62.8 cm), and hence was defined according to a German unit of length.

[105]Johan Daniel Berlin, 'Observat. Af Bar. Therm. Vind Og Veiret, for Aar 1763., I Tronh', *Trondhiemske Selskabs Skrifter* (Kiøbenhavn: Pelt, 1765), 465–89 (p. 465).

[106]Hasok Chang, *Inventing temperature: measurement and scientific progress* (Oxford: Oxford University Press, 2004), p. 60.

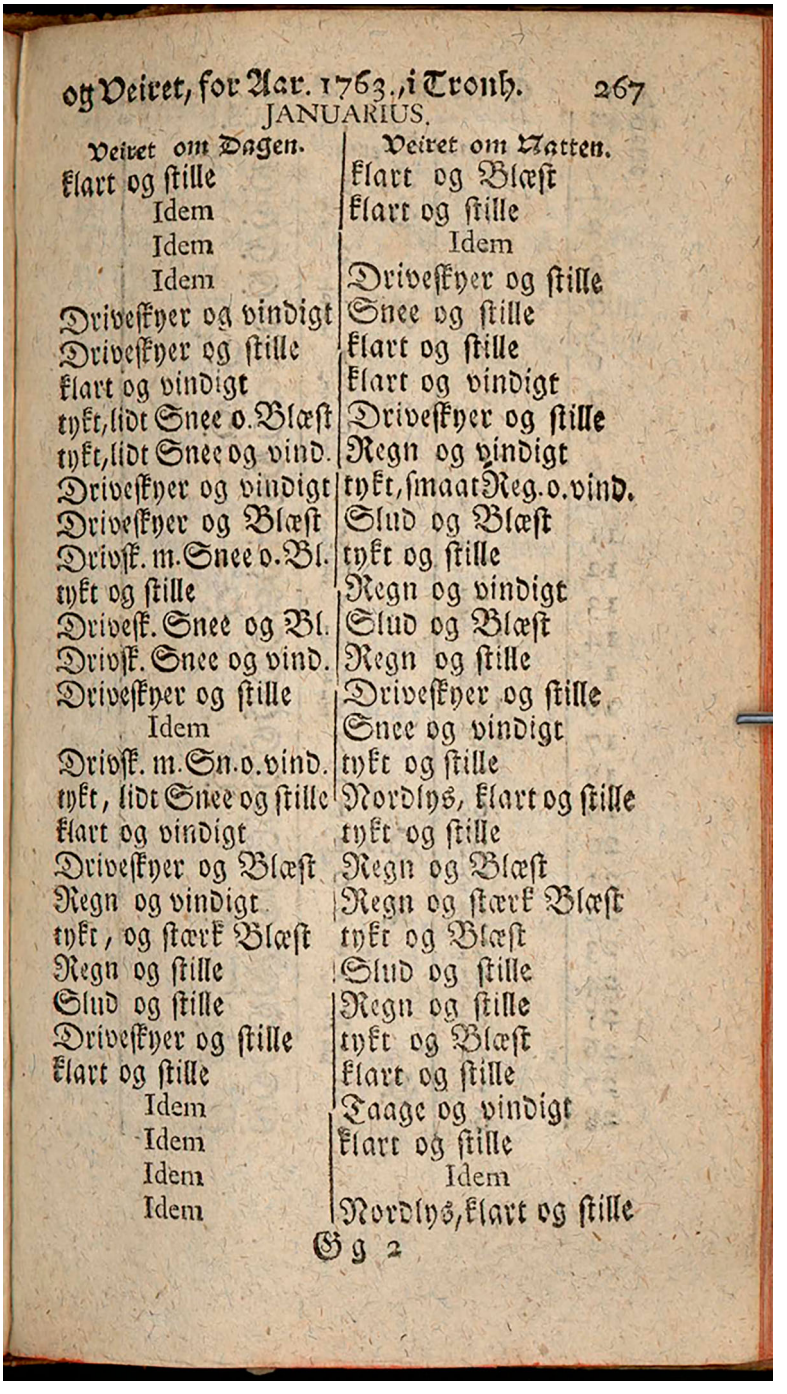
[107]Diderich Christian Fester, 'Betragtning over Luftens Almindelige Temperatur', *Skrifter*, ed. Det Kongelige norske videnskabers selskab (Kjøbenhavn: Prost og Storchs Forlag, 1798), 112–20.

[108]Marie-Theres Federhofer, 'Værtegn: Om Jacob Nicolaj Wilses (1735–1801) Meteorologiske Notasjonssystem', *Nordlit*, 2002, 91–102 (p. 97) <https://doi.org/10.7557/13.2070> [accessed 12 April 2023]

Figure 4. Johan Daniel Berlin's barometer, with measurement scale for summer, on the left side, and scale for winter, on the right. Image by Ivonne Geisler, NTNU University Museum.

to relay data without being overly subjective. Berlin for example described each weather phenomenon using the same, few; but key words. See Figure 5.

Wilse enjoyed a decidedly international reputation and both the *Académie Royale des Sciences et Belles-Lettres de Prusse* in Berlin and the journal of Göttingen's *Akademie der Wissenschaften*, *Göttingische gelehrte Anzeigen*, made favourable mention of his work. In 1781, the journal promoted Wilse's system of meteorological short-hand, the *Meteorographica compendiosa*:



og Veiret, for Aar. 1763., i Tronh. 267

JANUARIUS.

Veiret om Dagen.	Veiret om Natten.
klart og ſtille	klart og Blæſt
Idem	klart og ſtille
Idem	Idem
Idem	Driveſkyer og ſtille
Driveſkyer og vindigt	Snee og ſtille
Driveſkyer og ſtille	klart og ſtille
klart og vindigt	klart og vindigt
tykt, lidt Snee o. Blæſt	Driveſkyer og ſtille
tykt, lidt Snee og vind.	Regn og vindigt
Driveſkyer og vindigt	tykt, ſmaat Reg. o. vind.
Driveſkyer og Blæſt	Slud og Blæſt
Drivſk. m. Snee o. Bl.	tykt og ſtille
tykt og ſtille	Regn og vindigt
Driveſk. Snee og Bl.	Slud og Blæſt
Drivſk. Snee og vind.	Regn og ſtille
Driveſkyer og ſtille	Driveſkyer og ſtille
Idem	Snee og vindigt
Drivſk. m. Sn. o. vind.	tykt og ſtille
tykt, lidt Snee og ſtille	Nordlys, klart og ſtille
klart og vindigt	tykt og ſtille
Driveſkyer og Blæſt	Regn og Blæſt
Regn og vindigt	Regn og ſtærk Blæſt
tykt, og ſtærk Blæſt	tykt og Blæſt
Regn og ſtille	Slud og ſtille
Slud og ſtille	Regn og ſtille
Driveſkyer og ſtille	tykt og Blæſt
klart og ſtille	klart og ſtille
Idem	Taage og vindigt
Idem	klart og ſtille
Idem	Idem
Idem	Nordlys, klart og ſtille

Gg 2

Figure 5. Daytime-weather descriptions shown for 31 days of January, in the left column. Nightly readings shown, in the right column. Excerpt from Berlin's 'Observat. af Bar. Therm. Vind og Veiret, for Aar. 1764, i Tronh.' as published in *Skrifter*.

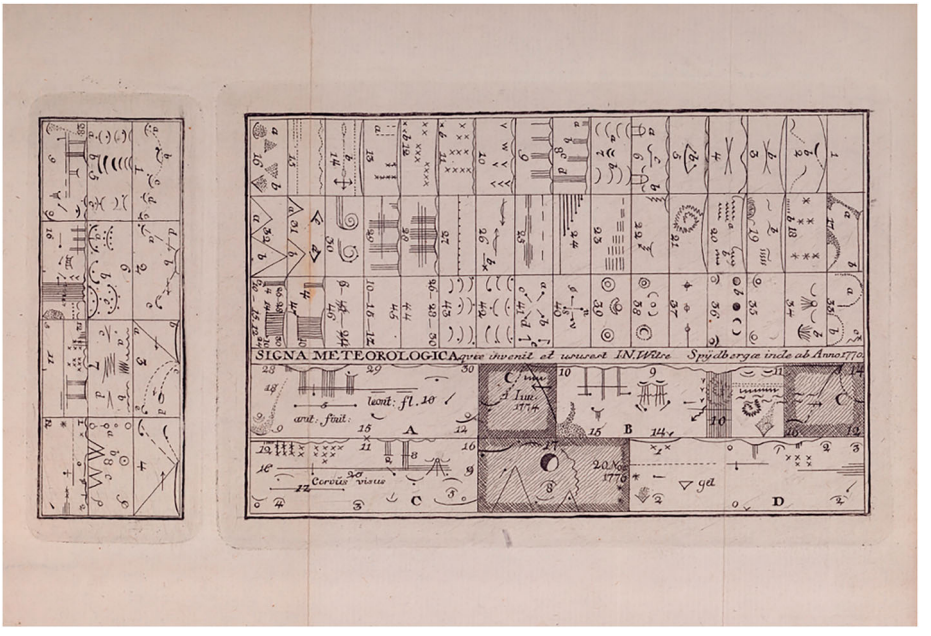


Figure 6. Wilse's *Meteorographia compendiosa* in which Wilse unveiled an international system of meteorological symbols. Circles, arrows, lines and spirals indicate sun, fog, rain and wind-strength levels from storm to calm; as well as symbols for wind direction. Illustration courtesy of the Gunnerus Library in Trondheim.

> In order to draw his weather observations quickly and conveniently, Mr. Wilse has invented signs for phenomena of air mass, which are easy to write down – [consisting of] merely straight and curved lines, as well as points; with no tricky combinations of these. They are naturally useful to those who wish to use signs to transcribe their observations. Not only is one spared the writing, but one also gets more effective oversight with one string of symbols than if one is forced to read multiple lines. […][109]

Wilse's *Meteorographia compendiosa* from 1778 offered a system of weather symbols (Figure 6) that replaced wordy descriptions of the weather, and that would have enabled scientists outside of Norway to learn of temperature, precipitation and cloud formation, in regions of Norway; without having to read descriptions translated into Danish, Norwegian or Russian.[110]

Wilse developed this shorthand system for atmospheric recordings in the context of his topographical studies, as weather observations provided further quantitative-statistical information about his regions of interest. This dual interest in weather and topography is significant because it reflected an international trend in the field of meteorology during the late eighteenth

[109]Federhofer, p. 98.
[110]Tore Stubberud, *J. N. Wilse: en opplysningsmann* (Rakkestad: Valdisholm forlag, 2016).

century when meteorology ceased to be a field that strictly dealt with phenomena above the earth.[111]

5. Conclusion

I have presented a Nordic Enlightenment science with some characteristic traits; natural philosophers who were either theologians or non-theologians, but often employed in the civil service; an ideal of useful science; national differences with respect to experimental science; a transnational interest in climate; shared conventions for data reporting and a common code of ethics; and shared fora for scientific activity. Such fora included academies of science, universities (to an extent), and a Republic of Letters.

Nordic, natural philosophers shared some common motives for practising science, like the desire to improve the fatherland's economy and people's welfare. In Enlightenment Norway, philosophers who made progress in their discipline were encouraged to share that progress, independent of discipline, to a greater community of minds. Bishop Gunnerus endorsed the reporting of weather observations and quantitative data on air pressure and temperature. Gunnerus (1761) is credited with having written on behalf of the *Det Trondhiemske Selskab* (precursor to DKNVS), in the preface of its first issue of *Skrifter*:

> Then we could not deny, that we in peculiarity wished that our fellow countrymen would [contribute] work dealing with the economy and natural history and send in to the Society their thermometric and barometrical observations … [112]

Nielsen (1896) writes that the first weather observations in Norway to be passed on to posterity came from ship logs from the end of the seventeenth century, alongside descriptions of 'certain nature phenomena with respective interpretations, well-suited to set the imagination of the superstitious masses into motion … '[113]

By the late eighteenth century, that focus on superstition and freak atmospheric phenomena had to a large extent given way to an interest in generalizations and a scientific approach to studying climate. Norway was by that point well-integrated into a larger scientific community of weather observers and other scientists of climate; disseminating data through meteorological networks, scientific articles and abiding by shared, transnational conventions. (Interestingly, the meteorological work of Berlin and Strøm has experienced renewed interest in recent decades.[114]) In light of this, it seems timely to

[111]Federhofer, p. 98.
[112]Det Trondhiemske Selskab, *Det Trondhjemske Selskabs Skrifter. Første Deel. Med Kobbere.*, 8 (Kiøbenhavn: Pelt, 1761), pp. 3–4.
[113]N.J. Nielsen. 'Videnskabernes Literatur i det nittende aarhundrede', *Illustreret norsk literaturhistorie*, eds. H. Jæger and O. Andersen (Kristiania: Hjalmar Biglers forlag, 1896), p. 165.
[114]Birkeland, pp. 5–6. See article by J.A. Kington 'Meteorological observing in Scandinavia and Iceland during the eighteenth century' in *Weather*, 27 (1972), 222–33. See H.H. Lamb's *Historic Storms of the North Sea, British Isles and Northwest Europe* (Cambridge: Cambridge University Press, 1991).

supplement a historiography which entertains claims that international conventions for observing, coding and transferring weather data in Norway were still not in place by the 1870s, and that weather-reporting prior to that belonged to the realm of 'folk-meteorology'.[115]

To conclude, I invite historians to re-examine the scientific contributions made by Norway's early-modern climate scientists, who regularly recorded weather observations according to scientific conventions of their time. Moreover, I argue that the development of a climate science during the Enlightenment can be seen against the backdrop of attitudes towards science that were both national, regional and transnational. Using the examples of four climate scientists in Norway who were employed in the civil service and/or the Church, I show that Norway's natural philosophers were integrated into transnational, networks of science.

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[115]Narve Fulsås, *Havet, døden og vêret: kulturell modernisering i kyst-Noreg 1850–1950* (Gjøvik: Det Norske Samlaget, 2003).